



# **STIC Search Report**

## **EIC 1700**

**STIC Database Tracking Number: 113149**

**TO: Raymond Alejandro**  
**Location: REM 6B59**  
**Art Unit : 1745**  
**February 2, 2004**

**Case Serial Number: 10/004980**

**From: Barba Koroma**  
**Location: EIC 1700**  
**REM EO4 A30**  
**Phone: 571 272 2546**

**barba.koroma@uspto.gov**

### **Search Notes**

Examiner Alejandro,  
Please find attached results of the search you requested. Various components of the claimed invention as spelt out in the claims were searched in multiple databases.

For your convenience, titles of hits have been listed to help you peruse the results set quickly. This is then followed by a detailed printout of records. Please let me know if you have any questions.  
Thanks.

=> file caplus

FILE 'CAPLUS' ENTERED AT 13:56:56 ON 02 FEB 2004

USE IS SUBJECT TO THE TERMS OF YOUR STN CUSTOMER AGREEMENT.

PLEASE SEE "HELP USAGETERMS" FOR DETAILS.

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FILE COVERS 1907 - 2 Feb 2004 VOL 140 ISS 6

FILE LAST UPDATED: 1 Feb 2004 (20040201/ED)

This file contains CAS Registry Numbers for easy and accurate substance identification.

=> file wpix

FILE 'WPIX' ENTERED AT 13:57:00 ON 02 FEB 2004

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FILE LAST UPDATED: 28 JAN 2004 <20040128/UP>

MOST RECENT DERWENT UPDATE: 200407 <200407/DW>

DERWENT WORLD PATENTS INDEX SUBSCRIBER FILE, COVERS 1963 TO DATE

>>> NEW WEEKLY SDI FREQUENCY AVAILABLE --> see NEWS <<<

>>> SLART (Simultaneous Left and Right Truncation) is now available in the /ABEX field. An additional search field /BIX is also provided which comprises both /BI and /ABEX <<<

>>> PATENT IMAGES AVAILABLE FOR PRINT AND DISPLAY <<<

>>> FOR A COPY OF THE DERWENT WORLD PATENTS INDEX STN USER GUIDE, PLEASE VISIT:  
[http://www.stn-international.de/training\\_center/patents/stn\\_guide.pdf](http://www.stn-international.de/training_center/patents/stn_guide.pdf) <<<

>>> FOR DETAILS OF THE PATENTS COVERED IN CURRENT UPDATES, SEE  
<http://thomsonderwent.com/coverage/latestupdates/> <<<

>>> FOR INFORMATION ON ALL DERWENT WORLD PATENTS INDEX USER GUIDES, PLEASE VISIT:  
<http://thomsonderwent.com/support/userguides/> <<<

>>> ADDITIONAL POLYMER INDEXING CODES WILL BE IMPLEMENTED FROM  
DERWENT UPDATE 200403.  
THE TIME RANGE CODE WILL ALSO CHANGE FROM 018 TO 2004.  
SDIS USING THE TIME RANGE CODE WILL NEED TO BE UPDATED.  
FOR FURTHER DETAILS: <http://thomsonderwent.com/chem/polymers/> <<<

=> file jicst

FILE 'JICST-EPLUS' ENTERED AT 13:57:04 ON 02 FEB 2004  
COPYRIGHT (C) 2004 Japan Science and Technology Agency (JST)

FILE COVERS 1985 TO 26 JAN 2004 (20040126/ED)

THE JICST-EPLUS FILE HAS BEEN RELOADED TO REFLECT THE 1999 CONTROLLED  
TERM (/CT) THESAURUS RELOAD.

=> file compendex

FILE 'COMPENDEX' ENTERED AT 13:57:10 ON 02 FEB 2004  
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FILE LAST UPDATED: 27 JAN 2004 <20040127/UP>  
FILE COVERS 1970 TO DATE.

<<< SIMULTANEOUS LEFT AND RIGHT TRUNCATION AVAILABLE IN  
THE BASIC INDEX >>>

=> d que

|     |   |         |     |             |        |        |                                                       |
|-----|---|---------|-----|-------------|--------|--------|-------------------------------------------------------|
| L2  | ( | 650)    | SEA | FILE=CAPLUS | ABB=ON | PLU=ON | COGENERATION? (4A) SYSTEM?                            |
| L3  | ( | 43353)  | SEA | FILE=CAPLUS | ABB=ON | PLU=ON | FUEL? (4A) CELL?                                      |
| L4  | ( | 272)    | SEA | FILE=CAPLUS | ABB=ON | PLU=ON | ORGANIC? (5A) RANK? AND CYCLE?                        |
| L5  | ( | 14699)  | SEA | FILE=CAPLUS | ABB=ON | PLU=ON | AIR (4A) COMPRESS?                                    |
| L6  | ( | 5889)   | SEA | FILE=CAPLUS | ABB=ON | PLU=ON | PUMP? (5A) LIQUID?                                    |
| L7  | ( | 108299) | SEA | FILE=CAPLUS | ABB=ON | PLU=ON | HIGH? (5A) (PRESS? OR TEMP?) AND<br>GAS               |
| L8  | ( | 46562)  | SEA | FILE=CAPLUS | ABB=ON | PLU=ON | (CYCLE? OR REMOV?) (4A) (HEAT?<br>OR ENERG?)          |
| L9  | ( | 2531)   | SEA | FILE=CAPLUS | ABB=ON | PLU=ON | COMBUST? AND FUEL? (5A) CELL?                         |
| L10 | ( | 43834)  | SEA | FILE=CAPLUS | ABB=ON | PLU=ON | (L2 OR L3)                                            |
| L11 | ( | 175)    | SEA | FILE=CAPLUS | ABB=ON | PLU=ON | ORGANIC? (4A) COOL? (4A) (FLUID?<br>OR LIQUID?)       |
| L12 | ( | 1410)   | SEA | FILE=CAPLUS | ABB=ON | PLU=ON | PUMP? AND COOL? (5A) LIQUID?                          |
| L13 | ( | 22)     | SEA | FILE=CAPLUS | ABB=ON | PLU=ON | HIGH? (4A) PRESS? (5A) COOL? (4A) FLU<br>ID?          |
| L14 | ( | 382)    | SEA | FILE=CAPLUS | ABB=ON | PLU=ON | HIGH? (4A) PRESS? (5A) COOL? AND<br>(FLUID OR LIQUID) |
| L15 | ( | 669982) | SEA | FILE=CAPLUS | ABB=ON | PLU=ON | (HEAT? OR HIGH?) (4A) TEMP?                           |
| L16 | ( | 91790)  | SEA | FILE=CAPLUS | ABB=ON | PLU=ON | L15 AND GAS                                           |
| L17 | ( | 4022)   | SEA | FILE=CAPLUS | ABB=ON | PLU=ON | EXPANDER?                                             |
| L18 | ( | 38568)  | SEA | FILE=CAPLUS | ABB=ON | PLU=ON | CONDENSER?                                            |
| L19 | ( | 5501)   | SEA | FILE=CAPLUS | ABB=ON | PLU=ON | CATALYT? (5A) COMBUST?                                |

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L20 (      2605)SEA FILE=CAPLUS ABB=ON  PLU=ON  ORGANIC?(5A)COOL?
L21 (      12)SEA FILE=CAPLUS ABB=ON  PLU=ON  L10 AND L9 AND L7 AND L16 AND
      L8
L22 (      0)SEA FILE=CAPLUS ABB=ON  PLU=ON  L17 AND L18 AND L19
L23 (     62)SEA FILE=CAPLUS ABB=ON  PLU=ON  L17 AND L18
L24 (    20502)SEA FILE=CAPLUS ABB=ON  PLU=ON  (L5 OR L6)
L25 (      3)SEA FILE=CAPLUS ABB=ON  PLU=ON  L4 AND L24
L26 (      4)SEA FILE=CAPLUS ABB=ON  PLU=ON  L11 AND L12
L27 (   153666)SEA FILE=CAPLUS ABB=ON  PLU=ON  (L7 OR L8)
L28 (    1195)SEA FILE=CAPLUS ABB=ON  PLU=ON  L7 AND L8
L29 (   671526)SEA FILE=CAPLUS ABB=ON  PLU=ON  (L12 OR L13 OR L14 OR L15 OR
      L16)
L30 (     854)SEA FILE=CAPLUS ABB=ON  PLU=ON  L19 AND ((L20 OR L21 OR L22 OR
      L23 OR L24 OR L25 OR L26 OR L27 OR L28 OR L29))
L31 (   4733)SEA FILE=CAPLUS ABB=ON  PLU=ON  L10 AND ((L20 OR L21 OR L22 OR
      L23 OR L24 OR L25 OR L26 OR L27 OR L28 OR L29))
L32 (     62)SEA FILE=CAPLUS ABB=ON  PLU=ON  L23 AND ((L20 OR L21 OR L22 OR
      L23 OR L24 OR L25 OR L26 OR L27 OR L28 OR L29))
L33 (   5607)SEA FILE=CAPLUS ABB=ON  PLU=ON  (L30 OR L31 OR L32)
L34 (      7)SEA FILE=CAPLUS ABB=ON  PLU=ON  L33 AND (CONDENSER? AND
      EXPANDER? AND HIGH?(4A) (TEMP? OR PRESS?) AND GAS?)
L35 (      3)SEA FILE=CAPLUS ABB=ON  PLU=ON  L33 AND CONDENSER? AND
      EXPANDER? AND COMBUST? AND GAS?
L36 (     990)SEA FILE=CAPLUS ABB=ON  PLU=ON  L33 AND COMBUST? AND GAS?
L37 (    674)SEA FILE=CAPLUS ABB=ON  PLU=ON  L36 AND HIGH?(4A) (TEMP? OR
      PRESS?) AND GAS?
L38 (     19)SEA FILE=CAPLUS ABB=ON  PLU=ON  L37 AND L5
L39 (      1)SEA FILE=CAPLUS ABB=ON  PLU=ON  L37 AND L6
L40 (     29)SEA FILE=CAPLUS ABB=ON  PLU=ON  L34 OR L35 OR L38 OR L39
L41 (    199)SEA FILE=WPIX ABB=ON  PLU=ON  FUEL?(4A)CELL? AND COMBUST? AND
      HIGH(5A) (PRESS? OR TEMP?) AND GAS
L42 (     19)SEA FILE=WPIX ABB=ON  PLU=ON  L41 AND CONDENS?
L43 (      2)SEA FILE=WPIX ABB=ON  PLU=ON  L41 AND LIQUID?(4A)COOL?
L44 (   131)SEA FILE=WPIX ABB=ON  PLU=ON  L41 AND HEAT?
L45 (     34)SEA FILE=WPIX ABB=ON  PLU=ON  L44 AND (COOL? OR CONDENS?)
L46 (     35)SEA FILE=WPIX ABB=ON  PLU=ON  L42 OR L43 OR L45
L47 (     14)SEA FILE=JICST-EPLUS ABB=ON  PLU=ON  L42 OR L43 OR L45
L48 (      6)SEA FILE=COMPENDEX ABB=ON  PLU=ON  L42 OR L43 OR L45
L49      84 DUP REM L40 L46 L47 L48 (0 DUPLICATES REMOVED)

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=> d ti 1-84

YOU HAVE REQUESTED DATA FROM FILE 'CAPLUS, WPIX, JICST-EPLUS, COMPENDEX' -  
CONTINUE? (Y)/N:y

L49 ANSWER 1 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI Fuel cell compound gas turbine system  
[Machine Translation].

L49 ANSWER 2 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN

- TI High-efficiency **fuel cell** power system with power generating expander
- L49 ANSWER 3 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI Integrated micro combined heat and power system
- L49 ANSWER 4 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI Conversion of coal to **fuel cell**-grade hydrogen and sequestration-ready carbon dioxide
- L49 ANSWER 5 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI **Gas**-firing **gas** turbine power generation apparatus with catalyst **combustor**
- L49 ANSWER 6 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI Conversion of coal to **fuel cell**-grade hydrogen and sequestration-ready carbon dioxide
- L49 ANSWER 7 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Energy supply station, for converting hydrocarbon fuel into hydrogen and/or electricity for delivery to vehicle, includes chemical converter(s), separation stage, collection element, and vehicle interface.
- L49 ANSWER 8 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Two stage cyclic preheating **high temperature** fuel battery power generating system.
- L49 ANSWER 9 OF 84 COMPENDEX COPYRIGHT 2004 EEI on STN  
TI Optimization of a MCFC/turbine hybrid system for cogeneration.
- L49 ANSWER 10 OF 84 COMPENDEX COPYRIGHT 2004 EEI on STN  
TI Multi-stage Solid Oxide **Fuel Cell - Gas** Turbine Combined Cycle Hybrid Power Plant System.
- L49 ANSWER 11 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI A light hydrocarbon fuel processor producing high-purity hydrogen
- L49 ANSWER 12 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI **Cogeneration system** for a **fuel cell**
- L49 ANSWER 13 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI Method and apparatus for total energy fuel conversion systems
- L49 ANSWER 14 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Energy supply station for converting hydrocarbon fuel into hydrogen and electricity for delivering to vehicle, has chemical converter(s), separation stage, carbon dioxide collection element and vehicle interface.
- L49 ANSWER 15 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Production of hydrogen used in zero emission hybrid power system by reacting steam with hydrocarbon in reaction zone containing reforming catalyst, and providing **heat** by employing flameless distributed

**combustion.**

- L49 ANSWER 16 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Fuel processor apparatus comprises catalytic tubular reactor and infrared radiant burner operated to **heat** a reactor, and to provide endothermic **heat** of reaction needed to reform mixture of hydrocarbon and steam.
- L49 ANSWER 17 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI **Heat** exchanger for fluids, comprises first and second fluid channels through which respective fluids may flow.
- L49 ANSWER 18 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Treatment of hydrocarbon containing formation in situ used in production of ammonia, involves controlling **heating** of selected section of formation so that average temperature of selected portion lies within preset range.
- L49 ANSWER 19 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Method of treating coal formation in situ for production of synthesis **gas**, involves transferring **heat** to selected portion of formation and controlling **heat** to attain specific mean temperature of formation.
- L49 ANSWER 20 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Treatment of hydrocarbon containing formation in situ used in production of oxygen, involves controlling **heating** of selected section of formation so that average temperature of selected portion lies within preset range.
- L49 ANSWER 21 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Treating coal formation in situ for production of e.g. ammonia for fertilizer, involves transferring **heat** to selected section of coal formation and controlling **heat** from **heat** sources to produce mixture.
- L49 ANSWER 22 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI In-situ treatment of hydrocarbon containing formation, e.g. formation containing coal, involves providing **heat** to different sections of the formation to allow pyrolysis of hydrocarbon.
- L49 ANSWER 23 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI In situ treatment of hydrocarbon containing formation for producing, e.g. hydrogen involves controlling **heat** from **heat** source(s) with specified average temperature within selected section of the formation.
- L49 ANSWER 24 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI In situ treatment of coal formation for production of e.g. phenol involves allowing **heat** to transfer from **heat** source to selected section of formation, controlling **heat** from **heat** source and producing mixture from formation.

- L49 ANSWER 25 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Method of treating coal formation in situ, involves transferring **heat** to selected section of coal formation and controlling **heat** from **heat** sources, so as to produce mixture from the formation.
- L49 ANSWER 26 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Chemical composition for use as electrode and electrolyte materials in devices, e.g. batteries, and for hydrogen production, includes transition metal compounds, aluminum, and soluble bases or electrolytes.
- L49 ANSWER 27 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI In situ treatment of hydrocarbon containing formation, e.g. coal formation, involves controlled **heating** of selected section of formation at specified temperature.
- L49 ANSWER 28 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Method of treating coal formation in situ for production of synthesis **gas**, involves transferring **heat** to selected portion of formation and controlling **heat** to attain specific mean temperature of formation.
- L49 ANSWER 29 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI In situ treatment of coal formation by providing **heat** to at least one portion of the formation, allowing **heat** to transfer from **heat** sources to selected section of formation and producing mixture from formation.
- L49 ANSWER 30 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Method of treating coal formation in situ for production of synthesis **gas**, involves transferring **heat** to selected portion of formation and controlling **heat** to attain specific mean temperature of formation.
- L49 ANSWER 31 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Reformer, for **fuel cell**, has **heat** insulating material attached to inner wall surface of box.
- L49 ANSWER 32 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Waste plastic processing and electricity generation integrated system has distillation drum to **condense** oil vapor produced during decomposition of plastic and supplies light **gas** from drum to power generating device.
- L49 ANSWER 33 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Hydrophilic coating film for solid polymer electrolyte type **fuel cells** and **heat** exchangers has surfactant on film surface comprising protein.
- L49 ANSWER 34 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Production of hydrogen from gaseous hydrocarbon, involves decomposing

hydrocarbon in presence of catalyst at **high temperature**  
, regenerating catalyst and reusing reaction **gases** produced  
during regeneration.

L49 ANSWER 35 OF 84 JICST-EPlus COPYRIGHT 2004 JST on STN

TI The development of high power output and high generation efficiency using  
LNG cold.

L49 ANSWER 36 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN

TI Integrated apparatus for generating power and/or oxygen enriched fluid,  
process for the operation thereof

L49 ANSWER 37 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN

TI Apparatus for power generation by combined **fuel cell**  
and **gas** turbine

L49 ANSWER 38 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN

TI Process and apparatus for production of **gaseous** and liquid  
nitrogen with a variable quantity of liquid by air cryogenic distillation

L49 ANSWER 39 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN

TI Process and apparatus for production of **gaseous** nitrogen by air  
cryogenic distillation

L49 ANSWER 40 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN

TI Retrofitting equipment for decreasing consumption of fossil fuels in an  
electric power plant using solar energy

L49 ANSWER 41 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

TI Reforming of feedstocks, useful in integrated **fuel cell**  
systems, involves **combusting** anode waste **gas** streams  
to provide **combustion** effluent streams and to reheat  
**cooled combustion** waste **gases**.

L49 ANSWER 42 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

TI Conversion of hydrocarbon reactants to diatomic hydrogen **gas** or  
ultrafine solid particles, involves **heating** hydrocarbon reactant  
stream in axial reactor, expanding and **heating** intermediate  
product stream obtained.

L49 ANSWER 43 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

TI Burner for partial **combustion** of e.g. methanol, ammonia, has  
cylindrical **combustion** space wall with flame holding tube,  
**heat** insulation multilayer board and water **cooled** layer  
arranged in order from inner to outer side.

L49 ANSWER 44 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

TI High-efficiency catalytic steam reformer producing hydrogen for  
**fuel cell** from range of hydrocarbon **fuels**,  
**cools** shift reactor and purification unit with **gases**  
leaving **fuel cell**.



- L49 ANSWER 45 OF 84 JICST-EPlus COPYRIGHT 2004 JST on STN  
TI Cycle Optimization and High Performance Analysis on the Hybrid Gas Turbine and **Fuel Cell** Systems.
- L49 ANSWER 46 OF 84 COMPENDEX COPYRIGHT 2004 EEI on STN  
TI Wind energy-hydrogen storage hybrid power generation.
- L49 ANSWER 47 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Fuel processor for producing a **gas** stream containing hydrogen includes **high temperature** shifts arranged in series in the **gas** stream path downstream of the catalyst.
- L49 ANSWER 48 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Catalytic burner, especially for **heating** evaporator in vehicle **fuel cell** system, has injectors for liquid fuel injection into fuel and oxidizing **gas** pre-mixing section and into **combustion** chamber.
- L49 ANSWER 49 OF 84 JICST-EPlus COPYRIGHT 2004 JST on STN  
TI Inverted Brayton Cycle for **Heat** Recovery of **Fuel Cell** (SOFC).
- L49 ANSWER 50 OF 84 JICST-EPlus COPYRIGHT 2004 JST on STN  
TI A Proposal of Using Inverted **Gas** Turbine for Efficient Energy Generation and Distribution in Japan.
- L49 ANSWER 51 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI **Fuel cell-gas** turbine power plants
- L49 ANSWER 52 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Current generation from hydrocarbon-containing **fuel cells**, especially **high temperature fuel cells** employing methane as **fuel**.
- L49 ANSWER 53 OF 84 JICST-EPlus COPYRIGHT 2004 JST on STN  
TI Simulation of Output Characteristics of SOFC and Combined Cycle.
- L49 ANSWER 54 OF 84 JICST-EPlus COPYRIGHT 2004 JST on STN  
TI 21st Century is the Age of **High Temperature Gas** Turbines.
- L49 ANSWER 55 OF 84 JICST-EPlus COPYRIGHT 2004 JST on STN  
TI The latest field test project of **fuel cell**. Field test of **fuel cell** in Tokyo Metropolitan Institute of Technology.
- L49 ANSWER 56 OF 84 JICST-EPlus COPYRIGHT 2004 JST on STN  
TI The latest field test project of **fuel cell**. Field test of **fuel cell** in Housetenboss (balance of district **heat/cooling** system and **fuel cell** in consideration of environmental conservation and energy conservation).

- L49 ANSWER 57 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI System for the simultaneous generation of electrical and thermal energy - has group of **high temperature fuel cells**, with thermal power machine and at least one other machine, such as **heat** pump or electrical generator, driven by the thermal power machine.
- L49 ANSWER 58 OF 84 JICST-EPlus COPYRIGHT 2004 JST on STN  
TI **Cool-fired** Power Generation Systems for the Future.
- L49 ANSWER 59 OF 84 JICST-EPlus COPYRIGHT 2004 JST on STN  
TI Power System. Development of Ultra High Efficiency Power Generation Technology for 21st Century. **Fuel Cell** Combined Power Generation Technology.
- L49 ANSWER 60 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI Method for starting up of **fuel cell** power plants
- L49 ANSWER 61 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI **Fuel cell** power plants
- L49 ANSWER 62 OF 84 JICST-EPlus COPYRIGHT 2004 JST on STN  
TI Main Research Activities at the Institute of Energy Process Engineering Research Centre Juelich Germany.
- L49 ANSWER 63 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Compact **high temperature fuel cell** - has spiral support rib with spaces between winding turns divided by membrane into anode and cathode spaces with **combustion gas** and air channels.
- L49 ANSWER 64 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI Apparatus for production of sulfuric acid
- L49 ANSWER 65 OF 84 JICST-EPlus COPYRIGHT 2004 JST on STN  
TI Thermally Sprayed Coatings for **High Temperature** Environments.
- L49 ANSWER 66 OF 84 JICST-EPlus COPYRIGHT 2004 JST on STN  
TI Best Mix Energy System with Cogeneration at Tokyo East 21 Project.
- L49 ANSWER 67 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Reducing carbon di oxide emission in electrochemical power generation - from methane and air in ceramic **high temperature fuel cell** giving separate nitrogen stream.
- L49 ANSWER 68 OF 84 JICST-EPlus COPYRIGHT 2004 JST on STN  
TI Talks of steam easy to understand.10.Electric power and **heat** generations from steam.
- L49 ANSWER 69 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI Efficient operation of **high-temperature**

hydrogen-oxygen **fuel cells** with ion-conducting electrolyte and hydrocarbon-derived hydrogen

- L49 ANSWER 70 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Electrical energy from solar energy - via methane deforming process and **fuel cell**.
- L49 ANSWER 71 OF 84 COMPENDEX COPYRIGHT 2004 EEI on STN  
TI Hydrogen fuel storage using activated carbon for vehicles.
- L49 ANSWER 72 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI Preheating systems for **fuel-cell** power plants
- L49 ANSWER 73 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI Apparatus for detecting the temperature in rapid thermal processing of semiconductor materials
- L49 ANSWER 74 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
TI Compact high-efficiency electrochemical **fuel cell** -  
using thin plates of plasma-sprayed oxide electrolyte alternating with thin grooved plates of nickel, gold or silicon carbide.
- L49 ANSWER 75 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI Cascade heat recovery with coproduct **gas** production
- L49 ANSWER 76 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI **Fuel-cell** power plant
- L49 ANSWER 77 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI Containment hydrogen removal system for a nuclear power plant
- L49 ANSWER 78 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI Molecular sieve zeolites as absorbents for **gaseous** fluids
- L49 ANSWER 79 OF 84 COMPENDEX COPYRIGHT 2004 EEI on STN  
TI EVALUATION OF ALTERNATIVE STEAM SOURCES FOR INDUSTRIAL COGENERATION.
- L49 ANSWER 80 OF 84 COMPENDEX COPYRIGHT 2004 EEI on STN  
TI HIGH-EFFICIENCY ELECTROCHEMICAL PLANT.
- L49 ANSWER 81 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI **High-pressure** manufacture of sulfuric acid
- L49 ANSWER 82 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI Refrigerator with a helium cooling cycle and **gas expander** for the retrograde condensation of hydrogen vapors
- L49 ANSWER 83 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI Air separation plant
- L49 ANSWER 84 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
TI Purification of carbon dioxide

=> d all 1-84 149

YOU HAVE REQUESTED DATA FROM FILE 'CAPLUS, WPIX, JICST-EPLUS, COMPENDEX' -  
CONTINUE? (Y)/N:y

L49 ANSWER 1 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
AN 2004:57887 CAPLUS  
ED Entered STN: 23 Jan 2004  
TI **Fuel cell compound gas turbine system**  
[Machine Translation].  
IN Tsuji, Tadashi  
PA Mitsubishi Heavy Industries, Ltd., Japan  
SO Jpn. Kokai Tokkyo Koho, 34 pp.  
CODEN: JKXXAF  
DT Patent  
LA Japanese  
IC ICM H01M008-00  
ICS F01K023-02; F02C006-00; H01M008-06; H01M008-12  
CC 52 (Electrochemical, Radiational, and Thermal Energy Technology)  
FAN.CNT 1

|      | PATENT NO.     | KIND | DATE     | APPLICATION NO. | DATE     |
|------|----------------|------|----------|-----------------|----------|
| PI   | JP 2004022230  | A2   | 20040122 | JP 2002-172540  | 20020613 |
| PRAI | JP 2002-172540 |      | 20020613 |                 |          |

AB [Machine Translation of Descriptors]. Make the design degree of freedom of the **fuel cell compound gas turbine system** high. **Gas turbine 10**, **compressor 2** and **combustor** has 4 and turbine 6. Portion of the **compressed air** which was made with **compressor 2 air** bleeding is done from **compressed step 2a** the middle, is sent to **fuel cell 20** by piping 40. The remaining **compressed air** burns, being sent to **combustor 4** as a **combustion air**, the natural **gas**, fuel such as **gas oil** and **gas oil** being supplied heavily here, generates the **combustion gas** of hot **high pressure**. This **combustion gas** being injected to turbine 6, turns this. Generator 30 is connected by the turbine shaft 8 which forms turbine 6, it meaning that generator 30 is driven due to the fact that turbine 6 turns elec. power occurs. After driving turbine 6, the **combustion gas** is discharged to outside **gas turbine 10** as an exhaust.

L49 ANSWER 2 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
AN 2003:717581 CAPLUS  
DN 139:233050  
ED Entered STN: 12 Sep 2003  
TI High-efficiency **fuel cell** power system with power generating expander  
IN Clawson, Lawrence G.; O'Brien, Christopher J.; Hagan, Mark R.

PA Nuvera Fuel Cells, Inc., USA  
 SO U.S. Pat. Appl. Publ., 15 pp., Cont.-in-part of U.S. Ser. No. 309,779.  
 CODEN: USXXCO  
 DT Patent  
 LA English  
 IC ICM H01M008-04  
 ICS H01M008-06  
 NCL 429026000; 429034000; 429020000; 429013000  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 Section cross-reference(s): 48

FAN.CNT 4

|      | PATENT NO.      | KIND | DATE     | APPLICATION NO. | DATE     |
|------|-----------------|------|----------|-----------------|----------|
| PI   | US 2003170518   | A1   | 20030911 | US 2002-335538  | 20021231 |
|      | US 2002004152   | A1   | 20020110 | US 2001-870412  | 20010530 |
|      | US 2003167768   | A1   | 20030911 | US 2002-309779  | 20021204 |
| PRAI | US 2000-208355P | P    | 20000531 |                 |          |
|      | US 2001-870412  | A2   | 20010530 |                 |          |
|      | US 2001-338637P | P    | 20011205 |                 |          |
|      | US 2002-309779  | A2   | 20021204 |                 |          |

AB A hydrogen fuel cell power system has improved efficiency and comprises a **fuel cell**, a source of hydrogen **gas**, a **compressor** for creating a pressurized air stream, and a liquid supply which is heated by waste heat from the power system and evaps. into the pressurized air stream to produce a pressurized air and steam mixture. The pressurized air/steam mixture, which is preferably used as the oxidant in the **fuel cell**, is combusted with **fuel** in a burner to produce a **high-temperature** steam-laden exhaust stream. The **high-temperature** steam-laden exhaust stream drives an expander to produce a power output, and a power take-off from the expander uses the expander power to, for instance, drive an elec. generator, or drive other system components. The evaporation of liquid can take place external to the **fuel cell**, or can take place directly within the **fuel cell**, preferably using a cooling liquid that is directly injected into the **fuel cell**. The **fuel cell** power system advantageously uses the low-**temperature** waste heat of the **fuel cell** to evaporate liquid into the pressurized air, resulting in a steam/air mixture having

a relatively large expansion potential. The systems and related methods of the invention are applicable to a wide range of **fuel cell** power systems, including a "pure" or "non-hybrid" **fuel cell** power system, powered by hydrogen from either an external source, such as a hydrogen storage tank, or from "direct" reforming of a fuel at the anode. The invention is also applicable to integrated or "hybridized" **fuel cell** power systems which contain a local fuel reformer. In these systems, the **fuel cell** is powered by hydrogen-containing reformat generated by the reformer.

ST **fuel cell** power system power generating expander  
 IT Exhaust **gases** (engine)

(heat recovery from; high-efficiency fuel cell power system with power generating expander)

IT Compressors  
Electric generators  
Fuel cells  
Heat exchangers  
Turbines  
(high-efficiency fuel cell power system with power generating expander)

IT Fuel cells  
(power plants; high-efficiency fuel cell power system with power generating expander)

IT Fuel gas manufacturing  
(reforming; high-efficiency fuel cell power system with power generating expander)

IT Waste heat  
(utilization; high-efficiency fuel cell power system with power generating expander)

IT 1333-74-0P, Hydrogen, uses  
RL: SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(high-efficiency fuel cell power system with power generating expander)

L49 ANSWER 3 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
AN 2003:118197 CAPLUS  
DN 138:139286  
ED Entered STN: 14 Feb 2003  
TI Integrated micro combined heat and power system  
IN Hanna, William Thompson; Anson, Donald; Stickford, George Henry; Coll, John Gordon  
PA USA  
SO U.S. Pat. Appl. Publ., 23 pp.  
CODEN: USXXCO  
DT Patent  
LA English  
IC ICM F01K025-08  
ICS F01K025-00  
NCL 060651000; 060671000  
CC 47-4 (Apparatus and Plant Equipment)  
Section cross-reference(s): 52, 69

FAN.CNT 1

|    | PATENT NO.                                                                                                                                                                                                                                                                                                                      | KIND | DATE     | APPLICATION NO. | DATE     |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------|-----------------|----------|
| PI | US 2003029169                                                                                                                                                                                                                                                                                                                   | A1   | 20030213 | US 2001-998705  | 20011130 |
|    | US 6598397                                                                                                                                                                                                                                                                                                                      | B2   | 20030729 |                 |          |
|    | WO 2003014534                                                                                                                                                                                                                                                                                                                   | A1   | 20030220 | WO 2002-US24618 | 20020802 |
| W: | AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, |      |          |                 |          |

UA, UG, UZ, VN, YU, ZA, ZM, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM  
 RW: GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW, AT, BE, BG,  
 CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL,  
 PT, SE, SK, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR,  
 NE, SN, TD, TG

PRAI US 2001-311514P P 20010810

US 2001-998705 A 20011130

AB An integrated system to provide both heat and elec. power is disclosed..  
 The integrated, or **cogeneration, system** operates with  
 an organic working fluid that circulates in a Rankine-type cycle, where the  
 organic working fluid is superheated by a heat source, expanded through an  
 involute spiral wrap (scroll) **expander** such that the organic  
 working fluid remains superheated through the **expander**, cooled  
 in a **condenser**, and pressurized by a pump. Heat exchange loops  
 within the system define hot water production capability for use in space  
 heating and domestic hot water, while the generator is coupled to the  
 scroll **expander** to generate electricity.

ST heat power system integrated micro combined

IT Thermodynamic cycle

(Rankine; integrated micro combined heat and power system)

IT Combustion apparatus

(chambers; integrated micro combined heat and power system)

IT Power

(generation; integrated micro combined heat and power system)

IT Hydrocarbons, uses

RL: TEM (Technical or engineered material use); USES (Uses)

(halo, refrigerant; integrated micro combined heat and power system)

IT Refrigerants

(halocarbon; integrated micro combined heat and power system)

IT Burners

**Condensers**

Exhaust gases (engine)

Heat

Heat exchangers

Heat pipes

Heat transfer

Pumps

(integrated micro combined heat and power system)

IT Power

(plants; integrated micro combined heat and power system)

IT Heaters

(radiant; integrated micro combined heat and power system)

IT Heaters

(water, domestic; integrated micro combined heat and power system)

IT 78-78-4, Isopentane 460-73-1, R-245Fa

RL: TEM (Technical or engineered material use); USES (Uses)

(integrated micro combined heat and power system)

L49 ANSWER 4 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN

AN 2003:118194 CAPLUS

DN 138:173152

ED Entered STN: 14 Feb 2003

TI Conversion of coal to **fuel cell**-grade hydrogen and  
sequestration-ready carbon dioxide  
IN Lyon, Richard K.  
PA General Electric Co., USA  
SO U.S. Pat. Appl. Publ., 7 pp.  
CODEN: USXXCO  
DT Patent  
LA English  
IC ICM C01B003-02  
ICS C10J003-68  
NCL 048077000; 423648100; 423437100; 048101000; 048210000; 422187000;  
422188000; 422189000  
CC 51-20 (Fossil Fuels, Derivatives, and Related Products)  
Section cross-reference(s): 49, 52

FAN.CNT 1

|      | PATENT NO.     | KIND | DATE     | APPLICATION NO. | DATE     |
|------|----------------|------|----------|-----------------|----------|
| PI   | US 2003029088  | A1   | 20030213 | US 2001-917801  | 20010731 |
|      | US 6669917     | B2   | 20031230 |                 |          |
|      | JP 2003236366  | A2   | 20030826 | JP 2002-220527  | 20020730 |
| PRAI | US 2001-917801 | A    | 20010731 |                 |          |

AB Coal is converted into **fuel cell**-quality hydrogen and  
"sequestration-ready" carbon dioxide by a combined steam  
**gasification** and semicoke **combustion** in the presence of  
a cyclic metal oxide-metal carbonate (FeO/Fe<sub>2</sub>O<sub>3</sub> and CaO/CaCO<sub>3</sub>) couple.  
The reactor system is characterized by a combination of two fluidized-bed  
reactors and a third transfer line reactor, in which the first  
fluidized-bed reactor is fed with coal particles (or semicoke) and  
**high-temperature** steam, and in which the second reactor is  
fluidized with **high-temperature** steam and the third reactor  
is fluidized with **compressed air**. Coal is  
**gasified** in a first fluidized-bed reactor with **high-**  
**temperature** steam, to produce substantially pure H and CO<sub>2</sub>. The mixture  
of the above solids are circulated among the three reactors, in which: (1)  
CaO present in the first reactor is reacted with CO<sub>2</sub> to form CaCO<sub>3</sub>, (2)  
CaCO<sub>3</sub> is reacted in the second reactor to regenerate CaO, and coal (or  
coal semicoke) is reacted with Fe<sub>2</sub>O<sub>3</sub> to form FeO and CO<sub>2</sub>, and (3) FeO is  
oxidized in the third reactor to regenerate Fe<sub>2</sub>O<sub>3</sub> and to produce  
oxygen-depleted air at **high temps**. Pure hydrogen,  
carbon dioxide, and oxygen-depleted air are withdrawn in sep. streams from  
the first, second, and third reactors. The reactors are operated at  
650-850° for the first reactor, 1000-1100° for the second  
reactor, and 1400-1600° for the third reactor.

ST coal steam **gasification fuel cell** hydrogen;  
calcium carbonate iron oxide coal steam **gasification** hydrogen;  
carbon dioxide coal steam **gasification** hydrogen

IT **Fuel cells**  
(hydrogen **fuels** for; conversion of coal to **fuel**  
**cell**-grade hydrogen and sequestration-ready carbon dioxide)

IT Coal **gasification**  
(steam; conversion of coal to **fuel cell**-grade  
hydrogen and sequestration-ready carbon dioxide)



IT 471-34-1, Calcium carbonate, processes 1305-78-8, Calcium oxide, processes 1309-37-1, Ferric oxide, processes 1345-25-1, Ferrous oxide, processes  
 RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PROC (Process)  
 (conversion of coal to **fuel cell**-grade hydrogen and sequestration-ready carbon dioxide)

IT 124-38-9P, Carbon dioxide, preparation 1333-74-0P, Hydrogen, preparation  
 RL: IMF (Industrial manufacture); PUR (Purification or recovery); PREP (Preparation)  
 (conversion of coal to **fuel cell**-grade hydrogen and sequestration-ready carbon dioxide)

IT 1344-28-1, Alumina, uses  
 RL: NUU (Other use, unclassified); USES (Uses)  
 (heat transfer agent; conversion of coal to **fuel cell**-grade hydrogen and sequestration-ready carbon dioxide)

L49 ANSWER 5 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN  
 AN 2003:150226 CAPLUS  
 DN 138:190547  
 ED Entered STN: 27 Feb 2003  
 TI Gas-firing gas turbine power generation apparatus with catalyst **combustor**  
 IN Murayama, Motohide; Kobayashi, Hideo  
 PA Ishikawajima-Harima Heavy Industries Co., Ltd., Japan  
 SO Jpn. Kokai Tokkyo Koho, 4 pp.  
 CODEN: JKXXAF  
 DT Patent  
 LA Japanese  
 IC ICM F02C007-22  
 ICS F02C003-30; F02C006-18; F23R003-40  
 CC 51-12 (Fossil Fuels, Derivatives, and Related Products)  
 Section cross-reference(s): 52

FAN.CNT 1

|      | PATENT NO.     | KIND | DATE     | APPLICATION NO. | DATE     |
|------|----------------|------|----------|-----------------|----------|
| PI   | JP 2003056364  | A2   | 20030226 | JP 2001-243124  | 20010810 |
| PRAI | JP 2001-243124 |      | 20010810 |                 |          |

AB The apparatus includes a low-pressure fuel injector for injection of fuel **gas**, preferably low-calorific **gas** fuel, into **air** before **compression** below the inflammability limit, a **high-pressure** fuel injector for injection of addnl. fuel, preferably liquid fuel, into the **combustor**, and a catalyst **combustor** for **catalytic combustion** of unburnt component in the **combustion** flue **gas**, to improve efficiency of power generation.

ST fuel **gas** turbine power generation injector catalyst **combustion combustor**

IT Calorific value  
 Combustion  
 Combustion apparatus  
 Combustion catalysts

**Combustion gases**

Flammability

Fuel gases

Injectors

Turbines

(gas-firing gas turbine power generation apparatus)

IT Power

(generation; gas-firing gas turbine power generation apparatus)

IT Fuels

(liquid; gas-firing gas turbine power generation apparatus)

L49 ANSWER 6 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN

AN 2003:96343 CAPLUS

DN 138:139909

ED Entered STN: 07 Feb 2003

TI Conversion of coal to **fuel cell**-grade hydrogen and sequestration-ready carbon dioxide

IN Lyon, Richard K.

PA General Electric Company, USA

SO Eur. Pat. Appl., 11 pp.

CODEN: EPXXDW

DT Patent

LA English

IC ICM C10J003-00

ICS C01B003-00

CC 51-20 (Fossil Fuels, Derivatives, and Related Products)

Section cross-reference(s): 49, 52

FAN.CNT 1

|    | PATENT NO. | KIND | DATE     | APPLICATION NO. | DATE     |
|----|------------|------|----------|-----------------|----------|
| PI | EP 1281747 | A2   | 20030205 | EP 2002-255300  | 20020730 |
|    | EP 1281747 | A3   | 20040102 |                 |          |

R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, LV, FI, RO, MK, CY, AL, TR, BG, CZ, EE, SK

PRAI US 2001-917801P P 20010731

AB Coal is converted into **fuel cell**-quality hydrogen and "sequestration-ready" carbon dioxide by a combined steam **gasification** and semicoke **combustion** in the presence of a cyclic metal oxide-metal carbonate (FeO/Fe<sub>2</sub>O<sub>3</sub> and CaO/CaCO<sub>3</sub>) couple. The reactor system is characterized by a combination of two fluidized-bed reactors and a third transfer line reactor, in which the first fluidized-bed reactor is fed with coal particles (or semicoke) and **high-temperature** steam, and in which the second reactor is fluidized with **high-temperature** steam and the third reactor is fluidized with **compressed air**. Coal is **gasified** in a first fluidized-bed reactor with **high-temperature** steam, to produce substantially pure H<sub>2</sub> and CO<sub>2</sub>. The mixture of the above solids are circulated among the three reactors, in which: (1) CaO present in the first reactor is reacted with CO<sub>2</sub> to form CaCO<sub>3</sub>, (2) CaCO<sub>3</sub> is reacted in the second reactor to regenerate CaO, and coal (or

coal semicoke) is reacted with Fe<sub>2</sub>O<sub>3</sub> to form FeO and CO<sub>2</sub>, and (3) FeO is oxidized in the third reactor to regenerate Fe<sub>2</sub>O<sub>3</sub> and to produce oxygen-depleted air at **high temps.** Pure hydrogen, carbon dioxide, and oxygen-depleted air are withdrawn in sep. streams from the first, second, and third reactors. The reactors are operated at 650-850° for the first reactor, 1000-1100° for the second reactor, and 1400-1600° for the third reactor.

ST coal steam **gasification fuel cell** hydrogen;  
calcium carbonate iron oxide coal steam **gasification** hydrogen;  
carbon dioxide coal steam **gasification** hydrogen

IT **Fuel cells**  
(hydrogen fuel for; conversion of coal to **fuel**  
**cell**-grade hydrogen and sequestration-ready carbon dioxide)

IT Coal **gasification**  
(steam; conversion of coal to **fuel cell**-grade  
hydrogen and sequestration-ready carbon dioxide)

IT 471-34-1, Calcium carbonate, processes 1305-78-8, Calcium oxide,  
processes 1309-37-1, Ferric oxide, processes 1345-25-1, Ferrous oxide,  
processes  
RL: CPS (Chemical process); PEP (Physical, engineering or chemical  
process); PROC (Process)  
(conversion of coal to **fuel cell**-grade hydrogen and  
sequestration-ready carbon dioxide)

IT 124-38-9P, Carbon dioxide, preparation 1333-74-0P, Hydrogen, preparation  
RL: IMF (Industrial manufacture); PUR (Purification or recovery); PREP  
(Preparation)  
(conversion of coal to **fuel cell**-grade hydrogen and  
sequestration-ready carbon dioxide)

IT 1344-28-1, Alumina, uses  
RL: NUU (Other use, unclassified); USES (Uses)  
(heat transfer agent; conversion of coal to **fuel cell**  
-grade hydrogen and sequestration-ready carbon dioxide)

L49 ANSWER 7 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

AN 2003-299456 [29] WPIX

DNN N2003-238226 DNC C2003-077939

TI Energy supply station, for converting hydrocarbon fuel into hydrogen  
and/or electricity for delivery to vehicle, includes chemical  
converter(s), separation stage, collection element, and vehicle interface.

DC E36 H06 L03 Q78 X16 X21

IN HSU, M S

PA (ZTEK-N) ZTEK CORP

CYC 99

PI US 2003008183 A1 20030109 (200329)\* 17p H01M008-00

WO 2003031047 A1 20030417 (200335) EN B01J007-00

RW: AT BE BG CH CY CZ DE DK EA EE ES FI FR GB GH GM GR IE IT KE LS LU  
MC MW MZ NL OA PT SD SE SK SL SZ TR TZ UG ZM ZW

W: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK  
DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR  
KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ OM PL PT RO  
RU SD SE SG SI SK SL TJ TM TN TR TT TZ UA UG UZ VN YU ZA ZM ZW

ADT US 2003008183 A1 CIP of US 2001-882618 20010615, US 2001-972783 20011005;

WO 2003031047 A1 WO 2002-US31687 20021004

PRAI US 2001-972783 20011005; US 2001-882618 20010615

IC ICM B01J007-00; H01M008-00

ICS B01J008-00; C01B003-02; C01B003-24; F28D021-00; H01M008-06

AB US2003008183 A UPAB: 20030505

NOVELTY - An energy supply station comprises:

(i) chemical converter(s) to receive fuel and for processing the fuel to form an output medium including carbon dioxide;

(ii) a separation stage for separating a chemical component from the output medium;

(iii) a collection element in liquid circuit with the separation stage for collecting the carbon dioxide; and

(iv) a vehicle interface for interfacing-with the vehicle.

USE - For converting hydrocarbon fuel into hydrogen and/or electricity for delivery to a vehicle.

ADVANTAGE - The device has operational efficiency, cost-effectiveness and versatility. It has also environmental advantage-zero emission of sulfur oxides, nitrogen oxides or carbon dioxide.

DESCRIPTION OF DRAWING(S) - The figure is a schematic block diagram illustrating the process flow of the reactants and exhaust in a low emission energy supply station.

Dwg.2/4

FS CPI EPI GMPI

FA AB; GI; DCN

MC CPI: E31-A02; E31-N05C; H06-A03; L03-E04; L03-E04A; L03-E04C; L03-E04F; L03-H05

EPI: X16-C; X21-A01F; X21-B01A

L49 ANSWER 8 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

AN 2003-855036 [80] WPIX

DNN N2003-682828

TI Two stage cyclic preheating **high temperature** fuel battery power generating system.

DC X11 X16

IN LI, W; YU, L

PA (UYSH-N) UNIV SHANGHAI JIAOTONG

CYC 1

PI CN 1442924 A 20030917 (200380)\* H01M008-00

ADT CN 1442924 A CN 2003-116306 20030410

PRAI CN 2003-116306 20030410

IC ICM H01M008-00

AB CN 1442924 A UPAB: 20031211

NOVELTY - A power generating system of **high-temperature**

**fuel cell** with two stages cycle preheating has two parts of the **high-temperature fuel cell**

and the auxiliary power generating systems with the features that reacting **gas** of positive and negative electrodes in the **fuel**

**cell** is preheated independently and the preheated reaction

**gas** is provided to both **fuel cells**. The

**fuel gas** is sent to the positive electrode of the first

and second storage **fuel cell** separately for power

generating after it is raised for its temperature, desulfurized and

heated by a surplus-heat boiler, the cooled exhaust gas of positive electrode of the fuel cell and partial raw fuel are sent into the surplus-heat boiler together for combustion to produce high-temperature and high-pressure steam to drive turbine for rotating the generator to produce electric energy after the exhaust gas of positive electrode in fuel cell is made for reducing its temperature by a heat exchanger.

Dwg.0/0

FS EPI

FA AB

MC EPI: X11-C04; X16-C09; X16-K

L49 ANSWER 9 OF 84 COMPENDEX COPYRIGHT 2004 EEI on STN

AN 2004(3):5502 COMPENDEX

TI Optimization of a MCFC/turbine hybrid system for cogeneration.

AU Karvountzi, Georgia C. (Henry Krumb School of Mines Columbia University, New York, NY 10027, United States); Price, Clifford M.; Duby, Paul F.

MT 2003 International Joint Power Generation Conference.

MO Power Division, ASME

ML Atlanta, GA, United States

MD 16 Jun 2003-19 Jun 2003

SO Proceedings of the 2003 International Joint Power Generation Conference 2003.p 865-872

ISBN: 0791836924

PY 2003

MN 62018

DT Conference Article

TC Theoretical

LA English

AB High temperature fuel cells can be

integrated in a hybrid cycle with a gas turbine and achieve lower heating value (LHV) efficiencies of about 70%. A hybrid cycle designed for cogeneration applications could lead to even higher LHV efficiencies such as 78% to 80% without post combustion and 85% - 90% with post combustion. The purpose of the present paper is to optimize the integration of a high temperature fuel cell in a cogeneration cycle. We used Gatecycle[trademark] heat balance software by GE Enter Software, LLC, to design a 20 - 80 MW high efficiency cogeneration plant. Since Gatecycle[trademark] does not have an icon for the fuel cell, we calculated the heat balance for the fuel cell stack in Microsoft[registered trademark] Excel and we imported the results into Gatecycle[trademark]. We considered a 8.5 MW, a 17 MW and a 34 MW fuel cell by scaling up of the commercially available 3MW molten carbonate fuel cell (MCFC). Our goal was to evaluate the optimum ratio between the fuel cell size and gas turbine size using a family of curves we developed showing LHV "electric" efficiency versus power for different ratios of "fuel cell - to - gas turbines size". Similar curves showing LHV "cogeneration"

efficiency are also presented. In addition configurations with a back pressure steam turbine and with a **condensing** steam turbine are evaluated. The influence of steam generation pressure in the overall system efficiency is discussed, as well as the performance of the hybrid system for different temperatures (0deg F - 80deg F) and elevations (0 ft - 3000 ft). Our conclusion is that **high temperature fuel cells** in a hybrid configuration with **gas** turbines could be successfully integrated into a cogeneration plant to achieve very high efficiencies. 10 Refs.

CC 702.2 Fuel Cells; 612.3 Gas Turbines and Engines; 614 Steam Power Plants; 701.1 Electricity: Basic Concepts and Phenomena; 617.2 Steam Turbines; 801.4.1 Electrochemistry

CT \***Fuel cells**; Catalysis; Optimization; Oxidation; Steam generators; Entropy; **Gas** turbines; Cogeneration plants; **Combustion**; Electricity; Steam turbines; Electrochemistry; Enthalpy

ST Cogeneration cycle; Hybrid systems; Power efficiency

ET F

L49 ANSWER 10 OF 84 COMPENDEX COPYRIGHT 2004 EEI on STN

AN 2004(2):3554 COMPENDEX

TI Multi-stage Solid Oxide **Fuel Cell - Gas** Turbine Combined Cycle Hybrid Power Plant System.

AU Tsuji, Tadashi (Mitsubishi Heavy Industries, Ltd. Takasago Machinery Works, Takasago, Hyogo 676-8686, Japan); Yanai, Noboru; Fujii, Kentaro; Miyamoto, Hitoshi; Watabe, Masaharu; Ishiguro, Tatsuo; Ohtani, Yuichi; Uechi, Hideyuki

MT 2003 ASME Turbo Expo.

MO International Gas Turbine Institute, ASME

ML Atlanta, GA, United States

MD 16 Jun 2003-19 Jun 2003

SO American Society of Mechanical Engineers, International Gas Turbine Institute, Turbo Expo (Publication) IGTI v 3 2003.p 249-253  
CODEN: AMGIE8

PY 2003

MN 62074

DT Conference Article

TC Theoretical; Experimental

LA English

AB Today, the need to develop more efficient thermal power systems that emit less greenhouse effect **gas** has become a paramount importance. In line with this awareness, our research has leapt into such development that the combination of SOFC and **Gas** Turbine could generate power at extremely high efficiency. In this paper, we would like to present our concept of Inter **Cooled** Multistage SOFC-GT Hybrid Power System, developed to maximize fuel **heat** input to the system. We propose the combination of F-class GT (TIT 1350deg C class) and 5 stage SOFC as the best for the hybrid power plant system and 77% (LHV base) is achieved at **high pressure** ratio. 5 Refs.

CC 702.2 Fuel Cells; 451.1 Air Pollution Sources; 612.3 Gas Turbines and Engines; 617.2 Steam Turbines; 618.1 Compressors; 616.1 Heat Exchange Equipment and Components

CT \*Solid oxide fuel cells; Optimization; Power generation; Cooling; Power plants; Greenhouse effect; Exhaust gases; Gas turbines; Steam turbines; Compressors; Heat exchangers; Combustors

ST Pressure ratio; Inter cooled multistage (ICM); Voltage efficiency

ET F

L49 ANSWER 11 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN

AN 2003:340067 CAPLUS

DN 139:182743

ED Entered STN: 05 May 2003

TI A light hydrocarbon fuel processor producing high-purity hydrogen

AU Loffler, Daniel G.; Taylor, Kyle; Mason, Dylan

CS IdaTech, LLC, Bend, OR, 97701, USA

SO Journal of Power Sources (2003), 117(1-2), 84-91

CODEN: JPSODZ; ISSN: 0378-7753

PB Elsevier Science B.V.

DT Journal

LA English

CC 52-1 (Electrochemical, Radiational, and Thermal Energy Technology)

AB This paper discusses the design process and presents performance data for a dual fuel (natural gas and LPG) fuel processor for PEM fuel cells delivering between 2 and 8 kW elec. power in stationary applications. The fuel processor resulted from design compromises made to address different design constraints. First, the product quality was selected; then, the unit operations needed to achieve that product quality were chosen from the pool of available technologies. Next, the specific equipment needed for each unit operation was selected. Finally, the unit operations were thermally integrated to achieve high thermal efficiency. Early in the design process, it was decided that the fuel processor would deliver high-purity hydrogen. Hydrogen can be separated from other gases by pressure-driven processes based on either selective adsorption or permeation. The pressure requirement made steam reforming (SR) the preferred reforming technol. because it does not require compression of combustion air; therefore, steam reforming is more efficient in a high-pressure fuel processor than alternative technologies like auto-thermal reforming (ATR) or partial oxidation (POX), where the combustion occurs at the pressure of the process stream. A low-temperature pre-reformer reactor is needed upstream of a steam reformer to suppress coke formation; yet, low temps. facilitate the formation of metal sulfides that deactivate the catalyst. For this reason, a desulfurization unit is needed upstream of the pre-reformer. Hydrogen separation was implemented using a palladium alloy membrane. Packed beds were chosen for the pre-reformer and reformer reactors primarily because of their low cost, relatively simple operation and low maintenance. Com., off-the-shelf balance of plant (BOP) components (pumps, valves, and heat exchangers) were used to integrate the unit operations. The fuel processor delivers up to 100 slm hydrogen >99.9% pure with <1 ppm CO, <3 ppm CO2. The thermal efficiency is better than 67% operating at full load. This fuel processor was integrated with a 5-kW fuel

- cell producing electricity and hot water.
- ST LPG natural gas steam reforming hydrogen power fuel cell; chem engineering design reforming desulfurization fuel cell power generation
- IT Apparatus  
(chemical apparatus, chemical plant equipment; light hydrocarbon fuel processor  
producing high-purity hydrogen for fuel cell power generation)
- IT Adsorption  
(desulfurization step; light hydrocarbon fuel processor producing high-purity hydrogen for fuel cell power generation)
- IT Adsorbents  
(for sulfur compds.; light hydrocarbon fuel processor producing high-purity hydrogen for fuel cell power generation)
- IT Petroleum products  
(gases, liquefied; light hydrocarbon fuel processor producing high-purity hydrogen for fuel cell power generation)
- IT Cation exchange membranes  
**Fuel cells**  
Power  
(light hydrocarbon fuel processor producing high-purity hydrogen for fuel cell power generation)
- IT Natural gas, uses  
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)  
(light hydrocarbon fuel processor producing high-purity hydrogen for fuel cell power generation)
- IT Methanation  
(of hydrogen permeate stream; light hydrocarbon fuel processor producing high-purity hydrogen for fuel cell power generation)
- IT Chemical engineering design  
(of integrated reforming-fuel cell power generation; light hydrocarbon fuel processor producing high-purity hydrogen for fuel cell power generation)
- IT Combustion  
(of non-hydrogen reformer products; light hydrocarbon fuel processor producing high-purity hydrogen for fuel cell power generation)
- IT Steam reforming  
(pre-reformer and reformer; light hydrocarbon fuel processor producing high-purity hydrogen for fuel cell power generation)
- IT 74-82-8, Methane, processes 7732-18-5, Water, processes 12795-06-1, Carbon oxide  
RL: CPS (Chemical process); FMU (Formation, unclassified); PEP (Physical,



engineering or chemical process); FORM (Formation, nonpreparative); PROC (Process)

(light hydrocarbon fuel processor producing high-purity hydrogen for **fuel cell** power generation)

IT 1333-74-0P, Hydrogen, uses

RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)

(light hydrocarbon fuel processor producing high-purity hydrogen for **fuel cell** power generation)

IT 7440-05-3D, Palladium, alloys

RL: DEV (Device component use); TEM (Technical or engineered material use); USES (Uses)

(membrane; light hydrocarbon fuel processor producing high-purity hydrogen for **fuel cell** power generation)

RE.CNT 11 THERE ARE 11 CITED REFERENCES AVAILABLE FOR THIS RECORD

RE

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(8) Rostrup-Nielsen, J; Catalysis Science and Technology 1983, V4

(9) Verduijn, W; Amm Plant Saf 1993, V33, P165 CAPLUS

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(11) Zalc, J; J Power Sources 2002, V111, P58 CAPLUS

L49 ANSWER 12 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN

AN 2002:245070 CAPLUS

ED Entered STN: 02 Apr 2002

TI **Cogeneration system for a fuel cell**

IN Lee, James H.; Siepierski, James S.; Woody, George R.

PA General Motors Corporation, USA

SO U.S., 7 pp.

CODEN: USXXAM

DT Patent

LA English

IC ICM H01M008-00

NCL 429013000

FAN.CNT 1

|      | PATENT NO.     | KIND | DATE     | APPLICATION NO. | DATE     |
|------|----------------|------|----------|-----------------|----------|
|      | -----          | ---- | -----    | -----           | -----    |
| PI   | US 6365289     | B1   | 20020402 | US 1999-469800  | 19991222 |
|      | US 2002055024  | A1   | 20020509 | US 2001-4980    | 20011207 |
|      | US 2002055025  | A1   | 20020509 | US 2001-5000    | 20011207 |
|      | US 2002055026  | A1   | 20020509 | US 2001-5928    | 20011207 |
| PRAI | US 1999-469800 | A3   | 19991222 |                 |          |

AB A **fuel cell** system and process using an **organic Rankine cycle** to produce shaft work to operate a **fuel cell** system component such as an **air compressor**. The **air compressor**

delivers **compressed air** to a **fuel cell stack**. The steps of the Rankine **cycle** include **pumping** a **liquid** working fluid to an elevated pressure, heating the fluid to a **gas**, expanding the **high temperature** and **high-pressure gas** through an expander to produce shaft work used to drive a **fuel cell system component** such as an **air compressor**, and then **removing energy** from the cooling fluid to change the **gas** back to a liquid, and repeating the **cycle**. The liquid fluid can be heated by an external boiler, or one of the components of the **fuel cell system** such as the **combustor** and/or the **fuel cell stack**.

RE.CNT 14 THERE ARE 14 CITED REFERENCES AVAILABLE FOR THIS RECORD

RE

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- (2) Benz; US 5645950 A 1997
- (3) Buswell; US 5340663 A 1994
- (4) Diethelm; US 5840437 A 1998 CAPLUS
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- (6) Dunbar; US 5335628 A 1994
- (7) Fuller; US 6068941 A 2000 CAPLUS
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- (9) Landau; US 5043232 A 1991
- (10) Palmer; US 5401589 A 1995
- (11) Pietrogrande; US 5314761 A 1994
- (12) Skowronski; US 5811201 A 1998 CAPLUS
- (13) Steinfeld; US 5554453 A 1996 CAPLUS
- (14) Sugita; US 4820594 A 1989 CAPLUS

L49 ANSWER 13 OF 84 CAPLUS COPYRIGHT 2004 ACS on STN

AN 2002:151465 CAPLUS

DN 136:202886

ED Entered STN: 27 Feb 2002

TI Method and apparatus for total energy fuel conversion systems

IN Ennis, Bernard P.; Cirrito, Anthony

PA EGT Developments, L.L.C., USA

SO U.S., 32 pp., Cont.-in-part of U.S. 5,938,975.

CODEN: USXXAM

DT Patent

LA English

IC ICM C07C001-02

ICS C07C004-02; C01B031-30; A61L009-00; B01B007-00

NCL 252373000

CC 51-7 (Fossil Fuels, Derivatives, and Related Products)

Section cross-reference(s): 52, 54

FAN.CNT 2

|    | PATENT NO.                                                         | KIND | DATE     | APPLICATION NO. | DATE     |
|----|--------------------------------------------------------------------|------|----------|-----------------|----------|
| PI | US 6350394                                                         | B1   | 20020226 | US 1999-331629  | 19990623 |
|    | US 5938975                                                         | A    | 19990817 | US 1996-771875  | 19961223 |
|    | WO 9830518                                                         | A1   | 19980716 | WO 1997-US23946 | 19971223 |
|    | W: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, |      |          |                 |          |

DK, EE, ES, FI, GB, GE, GH, HU, ID, IL, IS, JP, KE, KG, KP, KR,  
 KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ,  
 PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG,  
 US, UZ, VN, YU, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM  
 RW: GH, GM, KE, LS, MW, SD, SZ, UG, ZW, AT, BE, CH, DE, DK, ES, FI,  
 FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, BF, BJ, CF, CG, CI, CM,  
 GA, GN, ML, MR, NE, SN, TD, TG

US 2003074883 A1 20030424 US 2002-193068 20020711

PRAI US 1996-771875 A2 19961223

WO 1997-US23946 W 19971223

US 1999-276874 A1 19990326

AB An independent and conserved source of fuel and/or power comprises a top stage rocket engine firing up to 5000 F. at **high pressures**, delivering jet flows up to transonic velocities into a near adiabatic tunnel for mixing in general and/or for transforming reactants introduced to suit specific objectives. The related compression is supplied by an independent prime mover which compresses its exhaust and other recoverable fluids. Low grade flows, thereby upgraded in temperature and pressure, are adiabatically contained, are further upgraded in the tunnel to become part of the prescribed fuel for export at the tunnel ends; or fuel to be fired in a prime mover for elec. or other power, or hydrogen for chemical use. Expansion turbines for this purpose are relieved of the load used to **compress** the excess air in standard **gas** turbines thus increasing export power. A portion of the expansion turbine's exhaust becomes part of recoverable fluids. When oxygen is used instead of air, the **gases** through turbines are nitrogen-free with more **heat** capacity reducing turbine inlet **temps.** for the same power. When reactant transformation is specified, the larger water vapor content in the cycle enhances the water **gas**/shift autothermally for ammonia and/or power and alternatively for pyrolysis cracking for olefins and diolefins. Further, staging rocket engine reactors increases efficiency in boilers and steam turbines; and staging can produce sponge iron and/or iron carbide as well as expansion turbine power and **fuel cells** for peak and off-peak loads.

ST total energy fuel conversion system

IT Power

(generation; method and apparatus for total energy fuel conversion systems)

IT **Combustion gases**

Fuels

Oxidizing agents

Rocket engines

Synthesis **gas**

(method and apparatus for total energy fuel conversion systems)

IT Alkadienes

Alkenes, preparation

RL: IMF (Industrial manufacture); PREP (Preparation)

(method and apparatus for total energy fuel conversion systems)

IT Alkanes, reactions

RL: RCT (Reactant); RACT (Reactant or reagent)

(method and apparatus for total energy fuel conversion systems)

IT Carbonaceous materials (technological products)

RL: RCT (Reactant); RACT (Reactant or reagent)  
(method and apparatus for total energy fuel conversion systems)

IT Fuels  
(synthetic; method and apparatus for total energy fuel conversion systems)

IT 1333-74-0P, Hydrogen, preparation  
RL: CPS (Chemical process); EPR (Engineering process); IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); PYP (Physical process); RCT (Reactant); PREP (Preparation); PROC (Process); RACT (Reactant or reagent)  
(method and apparatus for total energy fuel conversion systems)

IT 12640-64-1, Iron carbide  
RL: CPS (Chemical process); EPR (Engineering process); PEP (Physical, engineering or chemical process); PYP (Physical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)  
(method and apparatus for total energy fuel conversion systems)

IT 74-86-2P, Acetylene, preparation  
RL: IMF (Industrial manufacture); PREP (Preparation)  
(method and apparatus for total energy fuel conversion systems)

IT 74-82-8P, Methane, preparation 74-85-1P, Ethylene, preparation  
RL: IMF (Industrial manufacture); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)  
(method and apparatus for total energy fuel conversion systems)

IT 74-84-0, Ethane, reactions 1332-37-2, Iron oxide, reactions  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(method and apparatus for total energy fuel conversion systems)

IT 7439-89-6, Iron, reactions  
RL: CPS (Chemical process); EPR (Engineering process); PEP (Physical, engineering or chemical process); PYP (Physical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)  
(sponge; method and apparatus for total energy fuel conversion systems)

RE.CNT 34 THERE ARE 34 CITED REFERENCES AVAILABLE FOR THIS RECORD  
RE

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- (3) Anon; WO 9820282 1998
- (4) Anon; WO 9941490 1999
- (5) Anon; WO 9944252 1999 CAPLUS
- (6) Anon; WO 9946032 1999 CAPLUS
- (7) Anon; WO 9961397 1999 CAPLUS
- (8) Anon; WO 9966262 1999 CAPLUS
- (9) Attia; US 6079197 A 2000
- (10) Barber; US 4121912 A 1978 CAPLUS
- (11) Beer; US 4845940 A 1989
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- (14) Byrnes; US 4884529 A 1989
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- (33) Wilkes; US 4313300 A 1982
- (34) Woods; US 6033793 A 2000 CAPLUS

L49 ANSWER 14 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
AN 2003-157059 [15] WPIX  
DNN N2003-123920 DNC C2003-040943  
TI Energy supply station for converting hydrocarbon fuel into hydrogen and  
electricity for delivering to vehicle, has chemical converter(s),  
separation stage, carbon dioxide collection element and vehicle interface.  
DC E36 H04 H06 L03 W06 X16 X21  
IN HSU, M S  
PA (ZTEK-N) ZTEK CORP  
CYC 96  
PI WO 2002103833 A1 20021227 (200315)\* EN 34p H01M008-06  
RW: AT BE CH CY DE DK EA ES FI FR GB GH GM GR IE IT KE LS LU MC MW MZ  
NL OA PT SD SE SL SZ TR TZ UG ZW  
W: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK  
DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR  
KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PL PT RO RU  
SD SE SG SI SK SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW  
ADT WO 2002103833 A1 WO 2001-US19117 20010615  
PRAI WO 2001-US19117 20010615  
IC ICM H01M008-06  
ICS B01D053-62  
AB WO2002103833 A UPAB: 20030303  
NOVELTY - Providing a relatively clean high performance energy low  
emission station employing one or more types of chemical converters.  
DETAILED DESCRIPTION - An energy supply station (302) has chemical  
converter(s) (316) positioned to receive hydrocarbon fuel and for  
processing the fuel to form an output medium containing carbon dioxide, a  
separation stage (318) for separating chemical component from output  
medium, a carbon dioxide collection element (320) provided in fluid  
circuit with separation stage and a vehicle interface for interfacing with  
a vehicle.  
An INDEPENDENT CLAIM is included for co-production of hydrogen and  
electricity in a station from a hydrocarbon fuel which involves  
co-producing hydrogen and electricity with chemical converters by  
processing the fuel to form output medium having carbon dioxide,  
separating a chemical component from the output medium and storing the  
hydrogen before being dispensed.

USE - For converting hydrocarbon fuel into hydrogen and electricity for delivering to vehicles such as automobiles, trucks, buses, trains, marine vessels, airplanes, space crafts and transporters and electricity produced is used for charging battery of electric vehicles at stations and used for commercial electric needs.

ADVANTAGE - The energy supply station efficiently produces hydrogen and/or electricity. Carbon dioxide, sulfur dioxide and nitrogen oxide emissions from the energy supply station are reduced or eliminated. The energy supply station is used in onsite installations and is used without changing existing infrastructures of electric supply grids, fuel supply trucks and pipelines. The economical energy supply station has high efficiency, utility, and performs carbon dioxide sequestration easily. The energy supply station achieves total system energy balance without requiring additional fuel and air **combustion** components. The waste **heat** produced from the chemical converter is utilized efficiently.

DESCRIPTION OF DRAWING(S) - The figure shows the schematic illustration of the low or zero emission energy supply station.

Energy supply station 302  
Vehicle interface 308  
Chemical converter(s) 316  
Separation stage 318  
Carbon dioxide collection element 320  
Storage element 322

Dwg.1/3

FS CPI EPI

FA AB; GI; DCN

MC CPI: E11-Q01; E11-S; E31-A02; E31-Q02; H04-E06; H04-F02E; H06-A03;  
L03-E04; N07-L03A

EPI: W06-B01C3; W06-C01C3; X16-C17; X21-A01F; X21-B01A

L49 ANSWER 15 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

AN 2002-682882 [73] WPIX

DNN N2002-539127 DNC C2002-192715

TI Production of hydrogen used in zero emission hybrid power system by reacting steam with hydrocarbon in reaction zone containing reforming catalyst, and providing **heat** by employing flameless distributed **combustion**.

DC E36 H04 H06 L03 M26 X16

IN MATZAKOS, A N; MIKUS, T; WARD, J M; WELLINGTON, S L

PA (SHEL) SHELL CANADA LTD; (SHEL) SHELL INT RES MIJ BV

CYC 101

PI WO 2002070402 A2 20020912 (200273)\* EN 69p C01B003-00

RW: AT BE CH CY DE DK EA ES FI FR GB GH GM GR IE IT KE LS LU MC MW MZ  
NL OA PT SD SE SL SZ TR TZ UG ZM ZW

W: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK  
DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR  
KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ OM PH PL PT  
RO RU SD SE SG SI SK SL TJ TM TN TR TT TZ UA UG UZ VN YU ZA ZM ZW

US 2003068260 A1 20030410 (200327) B01J008-02

US 2003068269 A1 20030410 (200327) C01B003-26

NO 2003003904 A 20031031 (200379) C01B003-34

EP 1365990 A2 20031203 (200380) EN C01B003-38

R: AL AT BE CH CY DE DK ES FI FR GB GR IE IT LI LT LU LV MC MK NL PT  
RO SE SI TR

ADT WO 2002070402 A2 WO 2002-EP2367 20020304; US 2003068260 A1 Provisional US  
2001-273353P 20010305, US 2002-91108 20020305; US 2003068269 A1  
Provisional US 2001-273354P 20010305, US 2002-91104 20020305; NO  
2003003904 A WO 2002-EP2367 20020304, NO 2003-3904 20030904; EP 1365990 A2  
EP 2002-718175 20020304, WO 2002-EP2367 20020304

FDT EP 1365990 A2 Based on WO 2002070402

PRAI US 2001-273354P 20010305; US 2001-273353P 20010305; US 2002-91108  
20020305; US 2002-91104 20020305

IC ICM B01J008-02; C01B003-00; C01B003-26; C01B003-34; C01B003-38

ICS B01J008-04; H01M008-06

AB WO 2002070402 A UPAB: 20021113

NOVELTY - Hydrogen is produced by reacting steam with a vaporizable hydrocarbon at 200-700 deg. C and at 1-200 bar in a reaction zone containing a reforming catalyst (9) to produce a mixture of primarily hydrogen and carbon dioxide with a lesser amount of carbon monoxide; and providing **heat** to the reaction zone by employing flameless distributed **combustion** (FDC) to drive the reaction.

DETAILED DESCRIPTION - Production of hydrogen involves:

(i) reacting steam with a vaporizable hydrocarbon at 200-700 deg. C and at 1-200 bar in a reaction zone containing a reforming catalyst to produce a mixture of primarily hydrogen and carbon dioxide (CO<sub>2</sub>) with a lesser amount of carbon monoxide (CO);

(ii) providing **heat** to the reaction zone by employing FDC to drive the reaction; and

(iii) conducting the reaction in the vicinity of a hydrogen-permeable and hydrogen-selective membrane (8), where hydrogen formed in the reaction zone permeates through the selective membrane and is separated from CO<sub>2</sub> and CO produced.

INDEPENDENT CLAIMS are included for the following:

(1) an apparatus for the production of hydrogen comprising:

(a) a membrane reforming steam (MRS) reactor comprising two concentric sections including a larger outside section and a smaller inside section and an annulus containing reforming catalyst between the sections;

(b) an annulus section having an inlet for steam and vaporizable hydrocarbon, a flow path for hydrogen and by-product **gases** resulting from reforming reactions taking place in the annulus section, and an outlet for the by-product **gases**;

(c) an outside section being in **heat** transfer contact with the annulus section and having an inlet for preheated air or other oxidant and tubes (10, 14) for fuel **gas**, where the tubes have openings through which oxidant resulting in FDC so uniform controlled **heat** is transferred to the annulus section; and

(d) inside section having a hydrogen-selective, hydrogen-permeable membrane positioned either on the inside or outside of the inside section and an outlet for hydrogen which permeates through the membrane from the annulus section into the inside section and passes through the outlet; and

(2) a **fuel** system comprising a **fuel cell** in communication with the apparatus.

USE - Used for production of hydrogen used in zero emission hybrid power system. It is also used in generating electricity (claimed).

ADVANTAGE - Produces pure hydrogen with minimal production of CO and virtually no CO in the hydrogen stream. It also provides CO2 capture for sequestration, employs a steam reforming membrane reactor and is empowered by flameless distributed **combustion** that provides great improvements in **heat** exchange efficiency.

DESCRIPTION OF DRAWING(S) - The figure is a schematic diagram of FDC-MRS reactor.

Membrane 8

Catalyst 9

Tubes 10, 14

Dwg.2/7

FS CPI EPI

FA AB; GI; DCN

MC CPI: E11-Q01; E31-A02; E31-N05C; H04-E06; H04-F02E; H06-A03; L03-E04;  
M26-B01; N02; N02-C01; N07-J; N07-L03A  
EPI: X16-C17

L49 ANSWER 16 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

AN 2002-608562 [65] WPIX

DNN N2002-481843 DNC C2002-172160

TI Fuel processor apparatus comprises catalytic tubular reactor and infrared radiant burner operated to **heat** a reactor, and to provide endothermic **heat** of reaction needed to reform mixture of hydrocarbon and steam.

DC E36 H06 L03 Q78 X16

IN DONAHUE, M B; WARREN, D W

PA (HARV-N) HARVEST ENERGY TECHNOLOGY INC

CYC 97

PI WO 2002062463 A1 20020815 (200265)\* EN 19p B01J008-00

RW: AT BE CH CY DE DK EA ES FI FR GB GH GM GR IE IT KE LS LU MC MW MZ  
NL OA PT SD SE SL SZ TR TZ UG ZW

W: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK  
DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR  
KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PH PL PT RO  
RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG UZ VN YU ZA ZW

US 6585785 B1 20030701 (200345) B01J008-00

ADT WO 2002062463 A1 WO 2001-US50298 20011019; US 6585785 B1 US 2000-696575  
20001027

PRAI US 2000-696575 20001027

IC ICM B01J008-00

ICS B01J008-02; B01J008-04; B01J008-06; C10J001-00; C10J003-20;  
F28D007-00; F28D021-00

AB WO 200262463 A UPAB: 20021010

NOVELTY - A fuel processor apparatus comprises a catalytic tubular reactor (8) and an infrared radiant burner (11) operated to **heat** the reactor, and to provide endothermic **heat** of reaction needed to reform a mixture of hydrocarbon and steam (4).

DETAILED DESCRIPTION - A fuel processor apparatus comprises a catalytic tubular reactor and an infrared radiant burner operated to **heat** the reactor, and to provide the endothermic **heat** of



reaction needed to reform a mixture of hydrocarbon and steam supplied to the reactor for the production of a hydrogen-rich gas stream fed to a **fuel cell**, and including a control responsive to temperature change of the burner, which in turn responds to variation in **fuel cell** electric load to adjust the feed of hydrocarbon to the catalytic tubular reactor.

An INDEPENDENT CLAIM is included for controlling hydrogen flow to a **fuel cell** is a process where hydrocarbon is treated at **high temperature** in a steam reformer to produce such hydrogen flow where hydrogen temperature is produced by a radiant burner comprising providing a return flow of off-gas hydrogen from the **fuel cell** for supply to the radiant burner for **combustion**; detecting changes in burner surface temperature; and controlling the flow of hydrogen supplied to the burner in responsive to the changes in burner surface temperature.

USE - Used as fuel processor.

ADVANTAGE - The apparatus is capable of delivering hydrogen to the proton exchange membrane **fuel cell** stack (41) with the electric load requirements which can change rapidly.

DESCRIPTION OF DRAWING(S) - The figure is a diagram of the overall process flow rate scheme of the fuel processing system.

Steam 4

Reformate 6

Reactor 8

Catalyst 9, 37

Burner 11

Water 17

**Fuel cell** stack 41

Anode off-gas 43

Air 44

Fuel 45

Dwg.1/2

FS CPI EPI GMPI

FA AB; GI; DCN

MC CPI: E31-A01; H06-A03; L03-E04A2; N02-D01; N03-F  
EPI: X16-C01C; X16-C17

L49 ANSWER 17 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

AN 2003-057510 [05] WPIX

CR 2002-597956 [64]

DNN N2003-044545 DNC C2003-014674

TI **Heat** exchanger for fluids, comprises first and second fluid channels through which respective fluids may flow.

DC A88 Q78 X16

IN DESPA, M S; HARRIS, C R; KELLY, K W

PA (DESP-I) DESPA M S; (HARR-I) HARRIS C R; (KELL-I) KELLY K W

CYC 1

PI US 2002125001 A1 20020912 (200305)\* 23p F28D007-02

ADT US 2002125001 A1 CIP of US 2000-501215 20000209, US 2001-3882 20011025

PRAI US 2001-3882 20011025; US 2000-501215 20000209

IC ICM F28D007-02

ICS F28F003-00

AB US2002125001 A UPAB: 20030501

NOVELTY - A **heat** exchanger comprises first and second fluid channels through which first and second fluids may flow, respectively. The first and second fluid channels interleave so that **heat** may be transferred between these fluid channels. The first fluid channels flow direction is perpendicular to a plane of the second fluid channels.

DETAILED DESCRIPTION - A **heat** exchanger comprises first fluid channels through which a first fluid may flow and second fluid channels through which a second fluid may flow. The second flow channels lie in a plane. The first and the second fluid channels interleave so that **heat** may be transferred between the fluid channels. The direction of the flow of the first fluid channels is perpendicular to the plane of the second fluid channels. A density of the first fluid channels is greater than 50/cm<sup>2</sup>. An INDEPENDENT CLAIM is also included for a method for fabricating a cross flow **heat** exchanger comprising manufacturing a polymer sheet having holes traversing the sheet, plating metal layer(s) on the surfaces of the polymer sheet including metal on the walls of the holes and removing the polymer without removing the metal.

USE - The **heat** exchanger is used for transferring **heat** between two fluids (claimed). It is used for enhancing **gas-side heat** exchange. It is used in aircraft **heat** exchange, air conditioning, portable **cooling** systems, systems and micro **combustion** chambers for **fuel** cells.

ADVANTAGE - The inventive **heat** exchanger has high efficiency, cross flow, fluid-fluid, micro **heat** exchanger formed from high ratio micro structures. It provides **high** mass flow rate, low **pressure** drop, and **high heat** transfer rates.

DESCRIPTION OF DRAWING(S) - The figure shows a three-dimensional view of a cross flow **heat** exchanger fabricated using an electrode-less deposition technique.

Dwg.10/12

FS CPI EPI GMPI

FA AB; GI

MC CPI: A11-C04B1; A12-W11G; A99-A  
EPI: X16-C09

L49 ANSWER 18 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

AN 2002-589135 [63] WPIX

CR 2001-648971 [74]; 2002-011222 [01]; 2002-017712 [02]; 2002-017713 [02];  
2002-017714 [02]; 2002-017715 [02]; 2002-017716 [02]; 2002-026174 [03];  
2002-026274 [03]; 2002-026277 [03]; 2002-034419 [04]; 2002-062257 [08];  
2002-267605 [31]; 2002-361205 [39]; 2002-425018 [45]; 2002-425019 [45];  
2002-425131 [45]; 2002-425269 [45]; 2002-425270 [45]; 2002-425271 [45];  
2002-425272 [45]; 2002-425308 [45]; 2002-425325 [45]; 2002-425348 [45];  
2002-433953 [46]; 2002-433954 [46]; 2002-433955 [46]; 2002-442917 [47];  
2002-443033 [47]; 2002-443034 [47]; 2002-443323 [47]; 2002-443411 [47];  
2002-453510 [48]; 2002-462626 [49]; 2002-462667 [49]; 2002-478723 [51];  
2002-478855 [51]; 2002-488664 [52]; 2002-488683 [52]; 2002-488689 [52];  
2002-488825 [52]; 2002-498950 [53]; 2002-499121 [53]; 2002-507184 [54];  
2002-526656 [56]; 2002-526662 [56]; 2002-526663 [56]; 2002-536469 [57];

2002-536470 [57]; 2002-536473 [57]; 2002-536493 [57]; 2002-546473 [58];  
 2002-546552 [58]; 2002-556416 [59]; 2002-556417 [59]; 2002-556440 [59];  
 2002-556441 [59]; 2002-556442 [59]; 2002-556443 [59]; 2002-556477 [59];  
 2002-556486 [59]; 2002-556487 [59]; 2002-556488 [59]; 2002-556614 [59];  
 2002-565615 [60]; 2002-565631 [60]; 2002-573643 [61]; 2002-573644 [61];  
 2002-582216 [62]; 2002-626390 [67]; 2002-642051 [69]; 2002-705764 [76];  
 2002-730939 [79]; 2002-741241 [80]; 2002-750833 [81]; 2003-045812 [04];  
 2003-045937 [04]; 2003-090588 [08]; 2003-174008 [17]; 2003-247687 [24];  
 2003-340818 [32]; 2003-354033 [33]; 2003-391555 [37]; 2003-416423 [39];  
 2003-456902 [43]; 2003-456904 [43]; 2003-481056 [45]; 2003-492660 [46];  
 2003-492839 [46]; 2003-531449 [50]; 2003-554765 [52]; 2003-576140 [54];  
 2003-778317 [73]; 2003-778318 [73]; 2003-786795 [74]; 2003-851506 [79];  
 2004-041710 [04]; 2004-068762 [07]

DNN N2002-467416 DNC C2002-166685

TI Treatment of hydrocarbon containing formation in situ used in production of ammonia, involves controlling **heating** of selected section of formation so that average temperature of selected portion lies within preset range.

DC A41 C04 E16 E17 E35 E36 H01 H04 H06 H09 Q49 X16

IN BERCHENKO, I E; FOWLER, T D; ROUFFIGNAC, E P D; RYAN, R C; SHAHIN, G T; STEGEMEIER, G L; VINEGAR, H J; WELLINGTON, S L; ZHANG, E; DE ROUFFIGNAC, E P

PA (BERC-I) BERCHENKO I E; (FOWL-I) FOWLER T D; (ROUF-I) ROUFFIGNAC E P D; (RYAN-I) RYAN R C; (SHAH-I) SHAHIN G T; (STEG-I) STEGEMEIER G L; (VINE-I) VINEGAR H J; (WELL-I) WELLINGTON S L; (ZHAN-I) ZHANG E; (SHEL) SHELL OIL CO

CYC 1

PI US 2002056552 A1 20020516 (200263)\* 462p E21B036-02  
 US 6581684 B2 20030624 (200343) E21B043-24

ADT US 2002056552 A1 Provisional US 2000-199213P 20000424, Provisional US 2000-199214P 20000424, Provisional US 2000-199215P 20000424, US 2001-841438 20010424; US 6581684 B2 Provisional US 2000-199213P 20000424, Provisional US 2000-199214P 20000424, Provisional US 2000-199215P 20000424, US 2001-841438 20010424

PRAI US 2001-841438 20010424; US 2000-199213P 20000424; US 2000-199214P 20000424; US 2000-199215P 20000424

IC ICM E21B036-02; E21B043-24

ICS E21B043-243; E21B043-30; E21B047-00

AB US2002056552 A UPAB: 20040128

NOVELTY - Treatment of hydrocarbon containing formation in situ, involves supplying **heat** from one or more **heat** sources to portion(s) of the formation, transferring **heat** from sources to selected section of formation, controlling **heat** from the sources such that average temperature within at least majority of the selected section of the formation is less than 375 deg. C, and producing a mixture from formation.

DETAILED DESCRIPTION - **Heat** from one or more **heat** sources is transferred to selected section of formation, **heat** is controlled so that average temperature within at least majority of selected section is less than 375 deg. C, at least some hydrocarbons within selected section is pyrolyzed and a mixture is produced. The selected section is **heated** so that thermal conductivity of

portion(s) of selected section is greater than about 0.5 W/(m deg. C).

INDEPENDENT CLAIMS are included for the following:

In situ method for **heating** hydrocarbon containing formation;

In situ method for producing hydrogen from hydrocarbon containing formation;

(1) Formation of **heater** wells in hydrocarbon containing formation;

(2) System configured to **heat** hydrocarbon containing formation;

(3) Mixture produced from a portion of hydrocarbon containing formation;

In situ production of synthesis **gas** from hydrocarbon containing formation;

(4) Method of forming spent portion of formation from hydrocarbon containing formation;

(5) Sequestering method of carbon dioxide within hydrocarbon containing formation;

In situ production of energy from hydrocarbon containing formation; and

(6) Production of ammonia using carbon containing formation.

USE - For production of synthesis **gas** used for synthesizing organic and/or inorganic compounds such as hydrocarbon and ammonia, for generating electricity by **combustion** as a fuel, reducing the pressure of synthesis **gas** in turbines and/or using the temperature of synthesis **gas** to make steel, for energy generation unit such as molten carbonate **fuel cell**, solid oxide **fuel cell** or other type of **fuel cell**, for paraffins production, for production of methanol, gasoline, diesel fuel, ammonia and middle distillates.

ADVANTAGE - Spacing between the **heat** sources is selected to increase effectiveness of **heat** sources, thereby increasing economic viability of selected in situ conversion process for hydrocarbons. The superposition of **heat** tends to increase the uniformity of **heat** distribution in the section of formation selected for treatment. The **heating** of hydrocarbon containing formation is accomplished in an economical way. Fewer **heat** sources are sufficient to **heat** greater portion of the formation. The system configured for **heating** formation has longer life time. The pyrolysis of the portion by superposition of **heat** produces relatively high, uniform permeability through the portion, which allows for generation of synthesis **gas** from a significant portion of the formation at relatively low **pressures**. The relatively **high** and uniform permeability result in relatively high recovery efficiency of synthesis **gas** as compared to synthesis **gas** generation in hydrocarbon containing formation that has not been treated. Electrical energy costs associated with **heating** at least a portion of the formation with an electric **heater** is reduced and a more economical process is provided for **heating** the hydrocarbon containing formation. Increasing the formation pressure to increase the amount of pyrolyzation fluids in the vapor phase permits increased recovery of lighter and high quality

pyrolyzation fluids. Carbon dioxide produced from the formation is used for feedstock for production of urea and/or may be reinjected into hydrocarbon containing formation for synthesis gas production and/or coal bed methane production. An oxidizing fluid is used to inhibit carbon deposition. High quality hydrogen, hydrocarbon and other products are produced.

Dwg.0/182

FS CPI EPI GMPI

FA AB; DCN

MC CPI: A01-D13; A01-F; C05-C01; C05-C04; C05-C08; C10-E04D; E10-E04E1;  
E31-N05B; E31-N05C; E32-A02; H01-D08; H04-E04; H04-E06; H06-A03;  
H06-B01; H06-B04; H09-C  
EPI: X16-C01A; X16-C02; X16-C15

L49 ANSWER 19 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

AN 2002-556488 [59] WPIX

CR 2001-648971 [74]; 2002-011222 [01]; 2002-017712 [02]; 2002-017713 [02];  
2002-017714 [02]; 2002-017715 [02]; 2002-017716 [02]; 2002-026174 [03];  
2002-026274 [03]; 2002-026277 [03]; 2002-034419 [04]; 2002-062257 [08];  
2002-267605 [31]; 2002-361205 [39]; 2002-425018 [45]; 2002-425019 [45];  
2002-425131 [45]; 2002-425269 [45]; 2002-425270 [45]; 2002-425271 [45];  
2002-425272 [45]; 2002-425308 [45]; 2002-425325 [45]; 2002-425348 [45];  
2002-433953 [46]; 2002-433954 [46]; 2002-433955 [46]; 2002-442917 [47];  
2002-443033 [47]; 2002-443034 [47]; 2002-443323 [47]; 2002-443411 [47];  
2002-453510 [48]; 2002-462626 [49]; 2002-462667 [49]; 2002-478723 [51];  
2002-478855 [51]; 2002-488664 [52]; 2002-488683 [52]; 2002-488689 [52];  
2002-488825 [52]; 2002-498950 [53]; 2002-499121 [53]; 2002-507184 [54];  
2002-526656 [56]; 2002-526662 [56]; 2002-526663 [56]; 2002-536469 [57];  
2002-536470 [57]; 2002-536473 [57]; 2002-536493 [57]; 2002-546473 [58];  
2002-546552 [58]; 2002-556416 [59]; 2002-556417 [59]; 2002-556440 [59];  
2002-556441 [59]; 2002-556442 [59]; 2002-556443 [59]; 2002-556477 [59];  
2002-556486 [59]; 2002-556487 [59]; 2002-556614 [59]; 2002-565615 [60];  
2002-565631 [60]; 2002-573643 [61]; 2002-573644 [61]; 2002-582216 [62];  
2002-589135 [63]; 2002-626390 [67]; 2002-642051 [69]; 2002-705764 [76];  
2002-730939 [79]; 2002-741241 [80]; 2002-750833 [81]; 2003-045812 [04];  
2003-045937 [04]; 2003-090588 [08]; 2003-174008 [17]; 2003-247687 [24];  
2003-340818 [32]; 2003-354033 [33]; 2003-391555 [37]; 2003-416423 [39];  
2003-456902 [43]; 2003-456904 [43]; 2003-481056 [45]; 2003-492660 [46];  
2003-492839 [46]; 2003-531449 [50]; 2003-554765 [52]; 2003-576140 [54];  
2003-778317 [73]; 2003-778318 [73]; 2003-786795 [74]; 2003-851506 [79];  
2004-041710 [04]; 2004-068762 [07]

DNN N2002-440427 DNC C2002-157748

TI Method of treating coal formation in situ for production of synthesis gas, involves transferring heat to selected portion of formation and controlling heat to attain specific mean temperature of formation.

DC A97 C04 E16 E17 E35 E36 H01 H04 H06 H09 Q49 X16

IN BERCHENKO, I E; FOWLER, T D; KARANIKAS, J M; ROUFFIGNAC, E P D; RYAN, R C;  
STEGEMEIER, G L; VINEGAR, H J; WELLINGTON, S L; ZHANG, E

PA (BERC-I) BERCHENKO I E; (FOWL-I) FOWLER T D; (KARA-I) KARANIKAS J M;  
(ROUF-I) ROUFFIGNAC E P D; (RYAN-I) RYAN R C; (STEG-I) STEGEMEIER G L;  
(VINE-I) VINEGAR H J; (WELL-I) WELLINGTON S L; (ZHAN-I) ZHANG E

CYC 1

PI US 2002053436 A1 20020509 (200259)\* 371p E21B036-02

ADT US 2002053436 A1 Provisional US 2000-199213P 20000424, Provisional US 2000-199214P 20000424, Provisional US 2000-199215P 20000424, US 2001-841637 20010424

PRAI US 2001-841637 20010424; US 2000-199213P 20000424; US 2000-199214P 20000424; US 2000-199215P 20000424

IC ICM E21B036-02

AB US2002053436 A UPAB: 20040128

NOVELTY - A portion of coal formation is **heated** using **heater(s)** (801). The **heat** is then transferred from **heater(s)** to a selected section of a formation. The **heat** from the **heater(s)** is controlled such that average temperature within majority of selected section of formation is less than 375 deg. C. Finally, a mixture is recovered from the formation.

DETAILED DESCRIPTION - A portion of coal formation is **heated** using **heater(s)**. The **heat** is then transferred from **heater(s)** to a selected section of formation. The **heat** from the **heater(s)** is controlled such that average temperature within majority of selected section of formation is less than 375 deg. C. Finally, a mixture is recovered from the formation. The hydrocarbons are optionally pyrolyzed within selected section of formation, during **heating**. The thermal conductivity of portion of selected section is greater than 0.5 W/(m deg. C). INDEPENDENT CLAIMS are also included for the following:

- (1) In situ method for **heating** coal formation;
- (2) In situ method for producing hydrogen from coal formation;
- (3) Method for forming **heater** wells in coal formation;
- (4) System configured to **heat** coal formation;
- (5) Mixture produced from a portion of coal formation;
- (6) In situ production of synthesis **gas** from coal formation;
- (7) Method of forming a spent portion of formation within coal formation;
- (8) Method of sequestering carbon dioxide within coal formation;
- (9) In situ production of energy from coal formation;
- (10) Production of ammonia using coal formation;
- (11) Treatment of hydrocarbons in at least a portion of coal formation.

USE - For **heating** coal formation including humic and/or sapropelic coal used for production of hydrocarbons, hydrogen and/or other products from coal formation. For production of synthesis **gas** used in the production of other products such as diesel, jet fuel, naphtha products, methane by catalytic methanation process, methanol, gasoline and diesel fuel, ammonia (for fertilizers) and middle distillates; for synthesizing a wide range of organic and/or inorganic compounds such as hydrocarbons and ammonia; to generate electricity by **combusting** it as a fuel, by reducing the pressure of synthesis **gas** in turbines and/or using the temperature of synthesis **gas** to make steam; and in energy generation unit such as molten carbonate **fuel cell**, solid oxide **fuel cell** or other type of **fuel cell**. Carbon dioxide in synthesis **gas**

produced from coal formation, is used for synthesis gas production and/or coal bed methane production.

**ADVANTAGE** - The coal formations are treated to yield relatively high quality hydrocarbon products, hydrogen, and other products.

**Cooling** of formation increases the strength of rock in the formation (thereby mitigating subsidence) and increases absorptive capacity of the formation. The in situ treatment of coal formation increases transfer of vapors through the treated portion of the formation. Therefore, a number of production wells required to produce a mixture from the formation may be reduced, thereby increasing economic viability of in situ conversion process. **High temperature** pumping of liquids from the production well is reduced or eliminated, which decreases production cost. **Heating** the production well prevents **condensation** and/or refluxing of production fluid, increases **heat** input into formation and increases formation permeability at or proximate the production well. By maintaining increased pressure within the formation facilitates production of formation fluids, facilitates generation of electricity from produced non-**condensable** fluid, and reduces or eliminates the need to compress formation fluid at a surface because the formation products are produced at higher pressure.

**DESCRIPTION OF DRAWING(S)** - The figure shows the generation of synthesis gas formation using pyrolysis water.

**Heater(s)** 801

Production well 825

Dwg.29/135

FS CPI EPI GMPI

FA AB; GI; DCN

MC CPI: A12-E06; A12-E10; A12-T03A; A12-W04B; A12-W10; A12-W11; C04-B01C3;  
 ~ C05-C01; C05-C06; C05-C08; C10-E04D; C14-T03; E05-S; E10-E04E1;  
 E11-G; E32-A01; E32-A03; H01-D08; H04-E04; H04-E06; H06-A03; H06-B01;  
 H06-B04; H09-C  
 EPI: X16-C01A; X16-C02; X16-C15

L49 ANSWER 20 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

AN 2002-536470 [57] WPIX

CR 2001-648971 [74]; 2002-011222 [01]; 2002-017712 [02]; 2002-017713 [02];  
 2002-017714 [02]; 2002-017715 [02]; 2002-017716 [02]; 2002-026174 [03];  
 2002-026274 [03]; 2002-026277 [03]; 2002-034419 [04]; 2002-062257 [08];  
 2002-267605 [31]; 2002-361205 [39]; 2002-425018 [45]; 2002-425019 [45];  
 2002-425131 [45]; 2002-425269 [45]; 2002-425270 [45]; 2002-425271 [45];  
 2002-425272 [45]; 2002-425308 [45]; 2002-425325 [45]; 2002-425348 [45];  
 2002-433953 [46]; 2002-433954 [46]; 2002-433955 [46]; 2002-442917 [47];  
 2002-443033 [47]; 2002-443034 [47]; 2002-443323 [47]; 2002-443411 [47];  
 2002-453510 [48]; 2002-462626 [49]; 2002-462667 [49]; 2002-478723 [51];  
 2002-478855 [51]; 2002-488664 [52]; 2002-488683 [52]; 2002-488689 [52];  
 2002-488825 [52]; 2002-498950 [53]; 2002-499121 [53]; 2002-507184 [54];  
 2002-526656 [56]; 2002-526662 [56]; 2002-526663 [56]; 2002-536469 [57];  
 2002-536473 [57]; 2002-536493 [57]; 2002-546473 [58]; 2002-546552 [58];  
 2002-556416 [59]; 2002-556417 [59]; 2002-556440 [59]; 2002-556441 [59];  
 2002-556442 [59]; 2002-556443 [59]; 2002-556477 [59]; 2002-556486 [59];  
 2002-556487 [59]; 2002-556488 [59]; 2002-556614 [59]; 2002-565615 [60];  
 2002-565631 [60]; 2002-573643 [61]; 2002-573644 [61]; 2002-582216 [62];

2002-589135 [63]; 2002-626390 [67]; 2002-642051 [69]; 2002-705764 [76];  
 2002-730939 [79]; 2002-741241 [80]; 2002-750833 [81]; 2003-045812 [04];  
 2003-045937 [04]; 2003-090588 [08]; 2003-174008 [17]; 2003-247687 [24];  
 2003-340818 [32]; 2003-354033 [33]; 2003-391555 [37]; 2003-416423 [39];  
 2003-456902 [43]; 2003-456904 [43]; 2003-481056 [45]; 2003-492660 [46];  
 2003-492839 [46]; 2003-531449 [50]; 2003-554765 [52]; 2003-576140 [54];  
 2003-778317 [73]; 2003-778318 [73]; 2003-786795 [74]; 2003-851506 [79];  
 2004-041710 [04]; 2004-068762 [07]

DNN N2002-424807 DNC C2002-152051

TI Treatment of hydrocarbon containing formation in situ used in production of oxygen, involves controlling **heating** of selected section of formation so that average temperature of selected portion lies within preset range.

DC A41 C04 E16 E17 E35 E36 H01 H04 H06 H09 Q49 X11 X16

IN BERCHENKO, I E; DE ROUFFIGNAC, E P; FOWLER, T D; MAHER, K A; RYAN, R C; SHAHIN, G T; STEGEMEIER, G L; VINEGAR, H J; WELLINGTON, S L; ZHANG, E  
 PA (BERC-I) BERCHENKO I E; (DROU-I) DE ROUFFIGNAC E P; (FOWL-I) FOWLER T D; (MAHE-I) MAHER K A; (RYAN-I) RYAN R C; (SHAH-I) SHAHIN G T; (STEG-I) STEGEMEIER G L; (VINE-I) VINEGAR H J; (WELL-I) WELLINGTON S L; (ZHAN-I) ZHANG E; (SHEL) SHELL OIL CO

CYC 1

PI US 2002046837 A1 20020425 (200257)\* 462p E21B043-24  
 US 6591906 B2 20030715 (200348) E21B043-24

ADT US 2002046837 A1 Provisional US 2000-199213P 20000424, Provisional US 2000-199214P 20000424, Provisional US 2000-199215P 20000424, US 2001-841297 20010424; US 6591906 B2 Provisional US 2000-199213P 20000424, Provisional US 2000-199214P 20000424, Provisional US 2000-199215P 20000424, US 2001-841297 20010424

PRAI US 2001-841297 20010424; US 2000-199213P 20000424; US 2000-199214P 20000424; US 2000-199215P 20000424

IC ICM E21B043-24

AB US2002046837 A UPAB: 20040128

NOVELTY - Treatment of hydrocarbon containing formation in situ, involves supplying **heat** from **heat** source(s) (801) to portion(s) of the formation, transferring **heat** from sources to selected section of formation (805), controlling **heat** from the sources such that average temperature within at least majority of the selected section of the formation is less than 375 deg. C, and producing a mixture from formation.

DETAILED DESCRIPTION - INDEPENDENT CLAIMS are included for the following:

- (1) In situ method for **heating** the hydrocarbon containing formation;
- (2) In situ method for producing hydrogen from hydrocarbon containing formation;
- (3) Formation method of **heater** wells in hydrocarbon containing formation;
- (4) System configured to **heat** hydrocarbon containing formation;
- (5) Mixture produced from a portion of hydrocarbon containing formation;
- (6) In situ production method of synthesis **gas** (823) from



hydrocarbon containing formation;

(7) Method of forming spent portion of formation from hydrocarbon containing formation;

(8) Sequestering method of carbon dioxide within hydrocarbon containing formation;

(9) In situ production of energy from hydrocarbon containing formation; and

(10) Production of oxygen using carbon containing formation.

USE - For production of synthesis **gas** used for synthesizing organic and/or inorganic compounds such as hydrocarbon and oxygen, for generating electricity by **combustion** as a fuel, reducing the pressure of synthesis **gas** in turbines and/or using the temperature of synthesis **gas** to make steam, for energy generation unit such as molten carbonate **fuel cell**, solid oxide **fuel cell** or other type of **fuel cell**, for paraffins production, for production of methanol, gasoline, diesel fuel, oxygen and middle distillates.

ADVANTAGE - Spacing between the **heat** sources is selected to increase effectiveness of **heat** sources, thereby increasing economic viability of selected in situ conversion process for hydrocarbons. The superposition of **heat** tends to increase the uniformity of **heat** distribution in the section of formation selected for treatment. The **heating** of hydrocarbon containing formation is accomplished in an economical way. Fewer **heat** sources are sufficient to **heat** greater portion of the formation. The system configured for **heating** formation has longer life time. The pyrolysis of the portion by superposition of **heat** produces relatively high, uniform permeability through the portion, which allows for generation of synthesis **gas** from a significant portion of the formation at relatively low **pressures**. The relatively **high** and uniform permeability result in relatively high recovery efficiency of synthesis **gas** as compared to synthesis **gas** generation in hydrocarbon containing formation that has not been treated. Electrical energy costs associated with **heating** at least a portion of the formation with an electric **heater** is reduced and a more economical process is provided for **heating** the hydrocarbon containing formation. Increasing the formation pressure to increase the amount of pyrolyzation fluids in the vapor phase permits increased recovery of lighter and high quality pyrolyzation fluids. Carbon dioxide produced from the formation is used for feedstock for production of urea and/or may be reinjected into hydrocarbon containing formation for synthesis **gas** production and/or coal bed methane production. An oxidizing fluid is used to inhibit carbon deposition. High quality hydrogen, hydrocarbon and other products are produced.

DESCRIPTION OF DRAWING(S) - The figure shows the use of pyrolysis water to generate synthesis **gas** in a formation.

Heat source 801

Selected section of formation 805

Synthesis **gas** 823

Dwg.29/182

FS CPI EPI GMPI

FA AB; GI; DCN

MC CPI: A01-D13; C05-C01; C05-C04; C05-C08; C10-J02; E10-J02D1; E31-A01;  
E31-A02; E31-D01; E31-N05B; E31-N05C; E32-A01; H01-D08; H04-E04;  
H04-E06; H06-A03; H06-B01; H06-B04; H09-C  
EPI: X11-A09; X16-C01A; X16-C02; X16-C15

L49 ANSWER 21 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

AN 2002-526662 [56] WPIX

CR 2001-648971 [74]; 2002-011222 [01]; 2002-017712 [02]; 2002-017713 [02];  
2002-017714 [02]; 2002-017715 [02]; 2002-017716 [02]; 2002-026174 [03];  
2002-026274 [03]; 2002-026277 [03]; 2002-034419 [04]; 2002-062257 [08];  
2002-267605 [31]; 2002-361205 [39]; 2002-425018 [45]; 2002-425019 [45];  
2002-425131 [45]; 2002-425269 [45]; 2002-425270 [45]; 2002-425271 [45];  
2002-425272 [45]; 2002-425308 [45]; 2002-425325 [45]; 2002-425348 [45];  
2002-433953 [46]; 2002-433954 [46]; 2002-433955 [46]; 2002-442917 [47];  
2002-443033 [47]; 2002-443034 [47]; 2002-443323 [47]; 2002-443411 [47];  
2002-453510 [48]; 2002-462626 [49]; 2002-462667 [49]; 2002-478723 [51];  
2002-478855 [51]; 2002-488664 [52]; 2002-488683 [52]; 2002-488689 [52];  
2002-488825 [52]; 2002-498950 [53]; 2002-499121 [53]; 2002-507184 [54];  
2002-526656 [56]; 2002-526663 [56]; 2002-536469 [57]; 2002-536470 [57];  
2002-536473 [57]; 2002-536493 [57]; 2002-546473 [58]; 2002-546552 [58];  
2002-556416 [59]; 2002-556417 [59]; 2002-556440 [59]; 2002-556441 [59];  
2002-556442 [59]; 2002-556443 [59]; 2002-556477 [59]; 2002-556486 [59];  
2002-556487 [59]; 2002-556488 [59]; 2002-556614 [59]; 2002-565615 [60];  
2002-565631 [60]; 2002-573643 [61]; 2002-573644 [61]; 2002-582216 [62];  
2002-589135 [63]; 2002-626390 [67]; 2002-642051 [69]; 2002-705764 [76];  
2002-730939 [79]; 2002-741241 [80]; 2002-750833 [81]; 2003-045812 [04];  
2003-045937 [04]; 2003-090588 [08]; 2003-174008 [17]; 2003-247687 [24];  
2003-340818 [32]; 2003-354033 [33]; 2003-391555 [37]; 2003-416423 [39];  
2003-456902 [43]; 2003-456904 [43]; 2003-481056 [45]; 2003-492660 [46];  
2003-492839 [46]; 2003-531449 [50]; 2003-554765 [52]; 2003-576140 [54];  
2003-778317 [73]; 2003-778318 [73]; 2003-786795 [74]; 2003-851506 [79];  
2004-041710 [04]; 2004-068762 [07]

DNN N2002-416808 DNC C2002-149143

TI Treating coal formation in situ for production of e.g. ammonia for  
fertilizer, involves transferring heat to selected section of  
coal formation and controlling heat from heat sources  
to produce mixture.

DC A41 C04 E16 E17 E35 E36 H01 H04 H06 H09 Q49

IN BERCHENKO, I E; HARDEVELD, R M V; MAHER, K A; ROUFFIGNAC, E P D; VINEGAR,  
H J; WARD, J M; WELLINGTON, S L; DE ROUFFIGNAC, E P; VAN HARDEVELD, R M  
PA (BERC-I) BERCHENKO I E; (HARD-I) HARDEVELD R M V; (MAHE-I) MAHER K A;  
(ROUF-I) ROUFFIGNAC E P D; (VINE-I) VINEGAR H J; (WARD-I) WARD J M;  
(WELL-I) WELLINGTON S L; (SHEL) SHELL OIL CO

CYC 1

PI US 2002043366 A1 20020418 (200256)\* 371p E21B036-02

US 6609570 B2 20030826 (200357) C01C001-04

ADT US 2002043366 A1 Provisional US 2000-199213P 20000424, Provisional US  
2000-199214P 20000424, Provisional US 2000-199215P 20000424, US  
2001-841131 20010424; US 6609570 B2 Provisional US 2000-199213P 20000424,  
Provisional US 2000-199214P 20000424, Provisional US 2000-199215P  
20000424, US 2001-841131 20010424

PRAI US 2001-841131 20010424; US 2000-199213P 20000424; US 2000-199214P 20000424; US 2000-199215P 20000424

IC ICM C01C001-04; E21B036-02

ICS E21B043-24; E21B043-34

AB US2002043366 A UPAB: 20040128

NOVELTY - Treating a coal formation in situ comprises:

- (1) providing **heat** from at least one **heat** source to at least one portion of the formation;
- (2) transferring the **heat** from the source(s) to a selected section;
- (3) controlling the **heat** from the **heat** source(s) so that an average temperature within at least a majority of the selected section is less than 375 deg. C and
- (4) producing a mixture.

DETAILED DESCRIPTION - INDEPENDENT CLAIMS are included for the following:

in situ method for **heating** a coal formation with an oxidizing fluid;

in situ method for producing hydrogen from a coal formation, where the hydrogen partial pressure within the mixture is greater than 0.5 bar;

- (1) forming **heater** wells in a coal formation which involves forming a well bore using magnetic tracking and providing a **heating** mechanism within the well bore;
  - (2) installing a **heater** well into a coal formation;
  - (3) a system configured to **heat** a coal formation;
  - (4) a mixture produced from a portion of a coal formation which comprises olefin content and average carbon number of less than 35;
- in situ production of synthesis **gas** (823) from a coal formation;
- (5) forming a spent portion of a formation within a coal formation;
  - (6) sequestering carbon dioxide within a coal formation;
- in situ production of energy from a coal formation;
- (7) producing ammonia using a coal formation; and
  - (8) treating hydrocarbons in at least a portion of a coal formation.

USE - Used for producing hydrogen, synthesis **gas**, carbon dioxide, energy and ammonia used for fertilizer (all claimed). The synthesis **gas** is **combusted** as fuel and is used to generate electricity, to make steam to run turbines and also in energy generation units like molten carbonate **fuel cell**, solid oxide **fuel cell** or other types of **fuel cells**. Carbon dioxide obtained from the formation is stored in deep cold beds, used to desorb coal bed methane. The spent portion of the coal formation is used to store and/or sequester other materials such as carbon dioxide.

ADVANTAGE - A mixture of relatively high quality hydrocarbon products, hydrogen and other products is obtained. **High temperature** pumping of liquids from production well is reduced or eliminated, which decreases production cost. **Heat** provided through the production well prevents **condensation** and/or refluxing of production fluid, increases **heat** input into the formation and/or increases formation permeability at or proximate the production well. Since permeability and/or porosity increases in the

heated formation, produced vapors flow considerable distances through the formation with relatively little pressure differential.

The hydrocarbons are pyrolyzed within a larger area of portion using fewer heat sources, as spacing between the heat sources is selected to increase the effectiveness of the heat source, thereby economic viability of selected in situ conversion process for hydrocarbon is increased. Uniformity of heat distribution in selected section of the formation is increased. The pressure of hydrogen in produced fluid is controlled, such that large amount of fluids having improved quality is provided.

DESCRIPTION OF DRAWING(S) - The figure shows the schematic diagram of using pyrolysis water to generate synthesis gas in a formation.

Heat source 801

Synthesis gas 823

Dwg.29/135

FS CPI GMPI

FA AB; GI; DCN

MC CPI: A01-D13; C05-C01; C05-C06; C05-C08; C10-E04D; C14-T03; E05-S; E10-E04E1; E32-A01; E32-A03; H01-D08; H04-E04; H04-E06; H06-A03; H09-D

L49 ANSWER 22 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

AN 2002-425348 [45] WPIX

CR 2001-648971 [74]; 2002-011222 [01]; 2002-017712 [02]; 2002-017713 [02]; 2002-017714 [02]; 2002-017715 [02]; 2002-017716 [02]; 2002-026174 [03]; 2002-026274 [03]; 2002-026277 [03]; 2002-034419 [04]; 2002-062257 [08]; 2002-267605 [31]; 2002-361205 [39]; 2002-425018 [45]; 2002-425019 [45]; 2002-425131 [45]; 2002-425269 [45]; 2002-425270 [45]; 2002-425271 [45]; 2002-425272 [45]; 2002-425308 [45]; 2002-425325 [45]; 2002-433953 [46]; 2002-433954 [46]; 2002-433955 [46]; 2002-442917 [47]; 2002-443033 [47]; 2002-443034 [47]; 2002-443323 [47]; 2002-443411 [47]; 2002-453510 [48]; 2002-462626 [49]; 2002-462667 [49]; 2002-478723 [51]; 2002-478855 [51]; 2002-488664 [52]; 2002-488683 [52]; 2002-488689 [52]; 2002-488825 [52]; 2002-498950 [53]; 2002-499121 [53]; 2002-507184 [54]; 2002-526656 [56]; 2002-526662 [56]; 2002-526663 [56]; 2002-536469 [57]; 2002-536470 [57]; 2002-536473 [57]; 2002-536493 [57]; 2002-546473 [58]; 2002-546552 [58]; 2002-556416 [59]; 2002-556417 [59]; 2002-556440 [59]; 2002-556441 [59]; 2002-556442 [59]; 2002-556443 [59]; 2002-556477 [59]; 2002-556486 [59]; 2002-556487 [59]; 2002-556488 [59]; 2002-556614 [59]; 2002-565615 [60]; 2002-565631 [60]; 2002-573643 [61]; 2002-573644 [61]; 2002-582216 [62]; 2002-589135 [63]; 2002-626390 [67]; 2002-642051 [69]; 2002-705764 [76]; 2002-730939 [79]; 2002-741241 [80]; 2002-750833 [81]; 2003-045812 [04]; 2003-045937 [04]; 2003-090588 [08]; 2003-174008 [17]; 2003-247687 [24]; 2003-340818 [32]; 2003-354033 [33]; 2003-391555 [37]; 2003-416423 [39]; 2003-456902 [43]; 2003-456904 [43]; 2003-481056 [45]; 2003-492660 [46]; 2003-492839 [46]; 2003-531449 [50]; 2003-554765 [52]; 2003-576140 [54]; 2003-778317 [73]; 2003-778318 [73]; 2003-786795 [74]; 2003-851506 [79]; 2004-041710 [04]; 2004-068762 [07]

DNN N2002-334472 DNC C2002-120391

TI In-situ treatment of hydrocarbon containing formation, e.g. formation containing coal, involves providing heat to different sections of the formation to allow pyrolysis of hydrocarbon.

DC A41 C04 E16 E17 E35 E36 H04 H06 H09 Q49 X27  
IN BERCHENKO, I E; FOWLER, T D; KEEDY, C R; ROUFFIGNAC, E P D; RYAN, R C;  
SHAHIN, G T; STEGEMEIER, G L; VINEGAR, H J; WELLINGTON, S L; ZHANG, E  
PA (BERC-I) BERCHENKO I E; (FOWL-I) FOWLER T D; (KEED-I) KEEDY C R; (ROUF-I)  
ROUFFIGNAC E P D; (RYAN-I) RYAN R C; (SHAH-I) SHAHIN G T; (STEG-I)  
STEGEMEIER G L; (VINE-I) VINEGAR H J; (WELL-I) WELLINGTON S L; (ZHAN-I)  
ZHANG E  
CYC 1  
PI US 2002040781 A1 20020411 (200245)\* 462p E21B043-243  
ADT US 2002040781 A1 Provisional US 2000-199213P 20000424, Provisional US  
2000-199214P 20000424, Provisional US 2000-199215P 20000424, US  
2001-841446 20010424  
PRAI US 2001-841446 20010424; US 2000-199213P 20000424; US 2000-199214P  
20000424; US 2000-199215P 20000424.  
IC ICM E21B043-243  
AB US2002040781 A UPAB: 20040128  
NOVELTY - Hydrocarbon containing formation is treated in-situ by providing  
heat to portion(s), preferably proximate the edge of the formation  
(805, 819); and allowing heat to transfer from heat  
source(s) (801) to the formation, so that the superimposed heat  
pyrolyzes the hydrocarbons to produce a mixture.  
DETAILED DESCRIPTION - INDEPENDENT CLAIMS are also included for:  
(1) a method of installing a heater well into a hydrocarbon  
containing formation comprising:  
(1) forming a bore in the ground using a steerable motor and an  
accelerometer; and  
(2) providing a heating mechanism within the bore such that  
the heating mechanism can transfer heat to a portion  
of the formation;  
(2) a system for heating a hydrocarbon containing formation  
comprising:  
(1) a heater disposed in an opening in the formation;  
(2) an oxidizing fluid source; and  
(3) a conduit disposed in the opening for providing an oxidizing  
fluid from the oxidizing fluid source to a reaction zone in the formation  
during use;  
(3) an in situ method for heating a hydrocarbon containing  
formation comprising:  
(1) heating a portion of the formation to a predetermined  
temperature to support reaction of hydrocarbons within the portion of the  
formation with an oxidizing fluid;  
(2) providing the oxidizing fluid to a reaction zone in the  
formation;  
(3) allowing the oxidizing fluid to react with the portion of the  
hydrocarbons at the reaction zone to generate heat at the  
reaction zone; and  
(4) transferring the generated heat by conduction from the  
reaction zone to a pyrolysis zone in the formation;  
(4) a composition produced from a portion of a hydrocarbon containing  
formation, comprising:  
(1) less than 10 weight% olefin; and  
(2) less than 35 average carbon number;

(5) a mixture prepared from a portion of a hydrocarbon containing formation comprises:

(1) non-**condensable** hydrocarbons comprising hydrocarbons having carbon numbers of less than 5, wherein a weight of ratio of hydrocarbons having carbon numbers from 2 - 4, to methan, is greater than approximately 1; and

(2) **condensable** hydrocarbons comprising oxygenated hydrocarbons of about 5% by weight of **condensable** component.

(6) a method for in situ production of synthesis **gas** (823) from a hydrocarbon containing formation comprising:

(1) **heating** a section of the formation to a certain temperature to allow synthesis **gas** generation;

(2) providing a synthesis **gas** generating fluid (821) to the section to generate synthesis **gas**; and

(3) removing synthesis **gas** from the formation;

(7) a method for in situ production of energy from a hydrocarbon containing formation comprising:

(1) providing **heat** from **heat** sources to a portion of the formation;

(2) allowing the **heat** to transfer from the **heat** sources to a selected section of the formation;

(3) producing pyrolysis products from the formation;

(4) providing a portion of the pyrolysis products to a reformer to generate synthesis **gas**;

(5) producing the synthesis gas from the reformer;

(6) providing a portion of the produced synthesis gas to a fuel cell to produce electricity; and

(7) storing a portion of the carbon dioxide in the carbon dioxide containing exit stream in a subsurface formation; and

(8) a method of forming a spent portion of formation within a hydrocarbon containing formation, comprising:

(1) heating a first portion of the formation to pyrolyze hydrocarbons within the first portion and to establish a substantially uniform permeability within the first portion; and

(2) cooling the first portion.

(9) a method of sequestering carbon dioxide within a hydrocarbon containing formation comprising heating a portion of the formation to increase permeability and form a uniform permeability within the portion, cooling the portion, and storing carbon dioxide within the portion.

(10) a method for producing ammonia using a carbon containing formation comprising:

(1) separating air to produce an oxygen-rich stream and a nitrogen-rich stream;

(2) heating a selected section of the formation to a predetermined temperature to support reaction of carbon-containing material in the formation to form synthesis gas;

(3) providing synthesis gas generating fluid and a portion of the oxygen rich stream to the selected section;

(4) allowing the synthesis gas generating fluid and oxygen in the oxygen-rich stream to react with a portion of the carbon-containing material in the formation to generate synthesis gas;

(5) producing synthesis gas from the formation, in which the

synthesis gas comprises hydrogen and carbon monoxide;

(6) providing a portion of the hydrogen in the synthesis gas to an ammonia synthesis process;

(7) providing nitrogen to the ammonia synthesis process; and

(8) using the ammonia synthesis process to generate ammonia.

USE - For producing hydrocarbons, hydrogen, and/or other products from hydrocarbons containing formations, e.g. formation containing coal; including lignite or sapropelic coal; oil shale; carbonaceous shale; shungites; kerogen and oil in low permeability matrix; heavy hydrocarbons; asphaltites; natural mineral waxes; formations in which kerogen is blocking production of other hydrocarbons.

ADVANTAGE - The method allows in situ conversion of hydrocarbons in high quality, and at reduced energy cost, thus more economical than the conventional method.

DESCRIPTION OF DRAWING(S) - The figure is schematic diagram showing the use of pyrolysis water for generating synthesis gas in a formation.

Heat source 801

Heater 803

Formation 805, 819

Gas and liquid streams 811, 813

Generating fluid 821

Synthesis gas 823

Production well 825

Dwg. 29/182

FS CPI EPI GMPI

FA AB; GI; DCN

MC CPI: A01-D13; C05-C01; C05-C06; C05-C08; C14-T03; E05-S; E32-A01; H04-E04; H06-B; H09-C

EPI: X27-E01A

L49 ANSWER 23 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

AN 2002-488689 [52] WPIX

CR 2001-648971 [74]; 2002-011222 [01]; 2002-017712 [02]; 2002-017713 [02];  
2002-017714 [02]; 2002-017715 [02]; 2002-017716 [02]; 2002-026174 [03];  
2002-026274 [03]; 2002-026277 [03]; 2002-034419 [04]; 2002-062257 [08];  
2002-267605 [31]; 2002-361205 [39]; 2002-425018 [45]; 2002-425019 [45];  
2002-425131 [45]; 2002-425269 [45]; 2002-425270 [45]; 2002-425271 [45];  
2002-425272 [45]; 2002-425308 [45]; 2002-425325 [45]; 2002-425348 [45];  
2002-433953 [46]; 2002-433954 [46]; 2002-433955 [46]; 2002-442917 [47];  
2002-443033 [47]; 2002-443034 [47]; 2002-443323 [47]; 2002-443411 [47];  
2002-453510 [48]; 2002-462626 [49]; 2002-462667 [49]; 2002-478723 [51];  
2002-478855 [51]; 2002-488664 [52]; 2002-488683 [52]; 2002-488825 [52];  
2002-498950 [53]; 2002-499121 [53]; 2002-507184 [54]; 2002-526656 [56];  
2002-526662 [56]; 2002-526663 [56]; 2002-536469 [57]; 2002-536470 [57];  
2002-536473 [57]; 2002-536493 [57]; 2002-546473 [58]; 2002-546552 [58];  
2002-556416 [59]; 2002-556417 [59]; 2002-556440 [59]; 2002-556441 [59];  
2002-556442 [59]; 2002-556443 [59]; 2002-556477 [59]; 2002-556486 [59];  
2002-556487 [59]; 2002-556488 [59]; 2002-556614 [59]; 2002-565615 [60];  
2002-565631 [60]; 2002-573643 [61]; 2002-573644 [61]; 2002-582216 [62];  
2002-589135 [63]; 2002-626390 [67]; 2002-642051 [69]; 2002-705764 [76];  
2002-730939 [79]; 2002-741241 [80]; 2002-750833 [81]; 2003-045812 [04];  
2003-045937 [04]; 2003-090588 [08]; 2003-174008 [17]; 2003-247687 [24];

2003-340818 [32]; 2003-354033 [33]; 2003-391555 [37]; 2003-416423 [39];  
2003-456902 [43]; 2003-456904 [43]; 2003-481056 [45]; 2003-492660 [46];  
2003-492839 [46]; 2003-531449 [50]; 2003-554765 [52]; 2003-576140 [54];  
2003-778317 [73]; 2003-778318 [73]; 2003-786795 [74]; 2003-851506 [79];  
2004-041710 [04]; 2004-068762 [07]

DNN N2002-386234 DNC C2002-138774

TI In situ treatment of hydrocarbon containing formation for producing, e.g. hydrogen involves controlling **heat** from **heat** source(s) with specified average temperature within selected section of the formation.

DC A41 C04 E16 E17 E35 E36 H01 H04 H06 H09 Q49 X11 X16

IN BERCHENKO, I E; FOWLER, T D; MAHER, K A; ROUFFIGNAC, E P D; RYAN, R C; SHAHIN, G T; STEGEMEIER, G L; VINEGAR, H J; WELLINGTON, S L; ZHANG, E

PA (BERC-I) BERCHENKO I E; (FOWL-I) FOWLER T D; (MAHE-I) MAHER K A; (ROUF-I) ROUFFIGNAC E P D; (RYAN-I) RYAN R C; (SHAH-I) SHAHIN G T; (STEG-I) STEGEMEIER G L; (VINE-I) VINEGAR H J; (WELL-I) WELLINGTON S L; (ZHAN-I) ZHANG E

CYC 1

PI US 2002040778 A1 20020411 (200252)\* 462p E21B036-02

ADT US 2002040778 A1 Provisional US 2000-199213P 20000424, Provisional US 2000-199214P 20000424, Provisional US 2000-199215P 20000424, US 2001-841301 20010424

PRAI US 2001-841301 20010424; US 2000-199213P 20000424; US 2000-199214P 20000424; US 2000-199215P 20000424

IC ICM E21B036-02

AB US2002040778 A UPAB: 20040128

NOVELTY - In situ treatment of hydrocarbon containing formation comprises transferring **heat** from **heat** source(s) (801) to a selected section of the formation. The **heat** is controlled from the **heat** sources such that an average temperature within a majority of the selected section of the formation is less than 375 deg. C. A mixture is produced from the formation.

DETAILED DESCRIPTION - INDEPENDENT CLAIMS are also included for:

(1) a method of installing a **heater** well into a hydrocarbon containing formation comprising:

(1) forming a bore in the ground using a steerable motor and an accelerometer; and

(2) providing a **heating** mechanism within the bore such that the **heating** mechanism can transfer **heat** to a portion of the formation;

(2) a system for **heating** a hydrocarbon containing formation comprising:

(1) a **heater** disposed in an opening in the formation;

(2) an oxidizing fluid source; and

(3) a conduit disposed in the opening for providing an oxidizing fluid from the oxidizing fluid source to a reaction zone in the formation during use;

(3) an in situ method for **heating** a hydrocarbon containing formation comprising:

(1) **heating** a portion of the formation to a predetermined temperature to support reaction of hydrocarbons within the portion of the formation with an oxidizing fluid;



- (2) providing the oxidizing fluid to a reaction zone in the formation;
- (3) allowing the oxidizing fluid to react with the portion of the hydrocarbons at the reaction zone to generate **heat** at the reaction zone; and
- (4) transferring the generated **heat** by conduction from the reaction zone to a pyrolysis zone in the formation;
- (4) a composition produced from a portion of a hydrocarbon containing formation, comprising:
  - (1) less than 10 weight% olefin; and
  - (2) less than 35 average carbon number;
  - (5) a mixture prepared from a portion of a hydrocarbon containing formation comprises:
    - (1) non-**condensable** hydrocarbons comprising hydrocarbons having carbon numbers of less than 5, wherein a weight of ratio of hydrocarbons having carbon numbers from 2 - 4, to methan, is greater than approximately 1; and
    - (2) **condensable** hydrocarbons comprising oxygenated hydrocarbons of about 5% by weight of **condensable** component.
  - (6) a method for in situ production of synthesis **gas** (823) from a hydrocarbon containing formation comprising:
    - (1) **heating** a section of the formation to a certain temperature to allow synthesis **gas** generation;
    - (2) providing a synthesis **gas** generating fluid (821) to the section to generate synthesis **gas**; and
    - (3) removing synthesis **gas** from the formation;
    - (7) a method for in situ production of energy from a hydrocarbon containing formation comprising:
      - (1) providing **heat** from **heat** sources to a portion of the formation;
      - (2) allowing the **heat** to transfer from the **heat** sources to a selected section of the formation;
      - (3) producing pyrolysis products from the formation;
      - (4) providing a portion of the pyrolysis products to a reformer to generate synthesis **gas**;
      - (5) producing the synthesis gas from the reformer;
      - (6) providing a portion of the produced synthesis gas to a fuel cell to produce electricity; and
      - (7) storing a portion of the carbon dioxide in the carbon dioxide containing exit stream in a subsurface formation; and
      - (8) a method of forming a spent portion of formation within a hydrocarbon containing formation, comprising:
        - (1) heating a first portion of the formation to pyrolyze hydrocarbons within the first portion and to establish a substantially uniform permeability within the first portion; and
        - (2) cooling the first portion.
      - (9) a method of sequestering carbon dioxide within a hydrocarbon containing formation comprising heating a portion of the formation to increase permeability and form a uniform permeability within the portion, cooling the portion, and storing carbon dioxide within the portion.
      - (10) a method for producing ammonia using a carbon containing formation comprising:

- (1) separating air to produce an oxygen-rich stream and a nitrogen-rich stream;
- (2) heating a selected section of the formation to a predetermined temperature to support reaction of carbon-containing material in the formation to form synthesis gas;
- (3) providing synthesis gas generating fluid and a portion of the oxygen rich stream to the selected section;
- (4) allowing the synthesis gas generating fluid and oxygen in the oxygen-rich stream to react with a portion of the carbon-containing material in the formation to generate synthesis gas;
- (5) producing synthesis gas from the formation, in which the synthesis gas comprises hydrogen and carbon monoxide;
- (6) providing a portion of the hydrogen in the synthesis gas to an ammonia synthesis process;
- (7) providing nitrogen to the ammonia synthesis process; and
- (8) using the ammonia synthesis process to generate ammonia.

USE - The method is used for the in situ treatment of hydrocarbons containing formation, for the production of hydrocarbons, and hydrogen.

ADVANTAGE - The method yields relatively high quality hydrocarbon products.

DESCRIPTION OF DRAWING(S) - The figure shows a schematic diagram of the use of water recovered from pyrolysis fluid production used to generate synthesis gas.

Heat source 801

Electrical heaters 803

First portion 805

Gas and liquid streams 811

Synthesis gas generating fluid 818

Synthesis gas 823

Production well 825

Dwg.29/182

FS CPI EPI GMPI

FA AB; GI; DCN

MC CPI: A01-D13; C05-C01; C05-C06; C05-C08; C10-E04D; C14-T03; E05-S;  
E10-E04E1; E32-A01; E32-A03; H01-C; H01-D08; H04-E04; H06-A; H09-A01A  
EPI: X11-A09; X16-C01A; X16-C02; X16-C15

L49 ANSWER 24 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

AN 2002-425269 [45] WPIX

CR 2001-648971 [74]; 2002-011222 [01]; 2002-017712 [02]; 2002-017713 [02];  
2002-017714 [02]; 2002-017715 [02]; 2002-017716 [02]; 2002-026174 [03];  
2002-026274 [03]; 2002-026277 [03]; 2002-034419 [04]; 2002-062257 [08];  
2002-267605 [31]; 2002-361205 [39]; 2002-425018 [45]; 2002-425019 [45];  
2002-425131 [45]; 2002-425270 [45]; 2002-425271 [45]; 2002-425272 [45];  
2002-425308 [45]; 2002-425325 [45]; 2002-425348 [45]; 2002-433953 [46];  
2002-433954 [46]; 2002-433955 [46]; 2002-442917 [47]; 2002-443033 [47];  
2002-443034 [47]; 2002-443323 [47]; 2002-443411 [47]; 2002-453510 [48];  
2002-462626 [49]; 2002-462667 [49]; 2002-478723 [51]; 2002-478855 [51];  
2002-488664 [52]; 2002-488683 [52]; 2002-488689 [52]; 2002-488825 [52];  
2002-498950 [53]; 2002-499121 [53]; 2002-507184 [54]; 2002-526656 [56];  
2002-526662 [56]; 2002-526663 [56]; 2002-536469 [57]; 2002-536470 [57];  
2002-536473 [57]; 2002-536493 [57]; 2002-546473 [58]; 2002-546552 [58];

2002-556416 [59]; 2002-556417 [59]; 2002-556440 [59]; 2002-556441 [59];  
 2002-556442 [59]; 2002-556443 [59]; 2002-556477 [59]; 2002-556486 [59];  
 2002-556487 [59]; 2002-556488 [59]; 2002-556614 [59]; 2002-565615 [60];  
 2002-565631 [60]; 2002-573643 [61]; 2002-573644 [61]; 2002-582216 [62];  
 2002-589135 [63]; 2002-626390 [67]; 2002-642051 [69]; 2002-705764 [76];  
 2002-730939 [79]; 2002-741241 [80]; 2002-750833 [81]; 2003-045812 [04];  
 2003-045937 [04]; 2003-090588 [08]; 2003-174008 [17]; 2003-247687 [24];  
 2003-340818 [32]; 2003-354033 [33]; 2003-391555 [37]; 2003-416423 [39];  
 2003-456902 [43]; 2003-456904 [43]; 2003-481056 [45]; 2003-492660 [46];  
 2003-492839 [46]; 2003-531449 [50]; 2003-554765 [52]; 2003-576140 [54];  
 2003-778317 [73]; 2003-778318 [73]; 2003-786795 [74]; 2003-851506 [79];  
 2004-041710 [04]; 2004-068762 [07]

DNN N2002-334403 DNC C2002-120366

TI In situ treatment of coal formation for production of e.g. phenol involves allowing **heat** to transfer from **heat** source to selected section of formation, controlling **heat** from **heat** source and producing mixture from formation.

DC A41 C04 E16 E17 E35 E36 H04 H06 H09 Q49 X27

IN BERCHENKO, I E; FOWLER, T D; KARANIKAS, J M; ROUFFIGNAC, E P D; RYAN, R C; STEGEMEIER, G L; VINEGAR, H J; WELLINGTON, S L; ZHANG, E; DE ROUFFIGNAC, E P

PA (BERC-I) BERCHENKO I E; (FOWL-I) FOWLER T D; (KARA-I) KARANIKAS J M; (ROUF-I) ROUFFIGNAC E P D; (RYAN-I) RYAN R C; (STEG-I) STEGEMEIER G L; (VINE-I) VINEGAR H J; (WELL-I) WELLINGTON S L; (ZHAN-I) ZHANG E; (SHEL) SHELL OIL CO

CYC 1

PI US 2002038708 A1 20020404 (200245)\* 371p E21B043-30  
 US 6607033 B2 20030819 (200356) E21B043-24

ADT US 2002038708 A1 Provisional US 2000-199213P 20000424, Provisional US 2000-199214P 20000424, Provisional US 2000-199215P 20000424, US 2001-841291 20010424; US 6607033 B2 Provisional US 2000-199213P 20000424, Provisional US 2000-199214P 20000424, Provisional US 2000-199215P 20000424, US 2001-841291 20010424

PRAI US 2001-841291 20010424; US 2000-199213P 20000424; US 2000-199214P 20000424; US 2000-199215P 20000424

IC ICM E21B043-24; E21B043-30

ICS E21B043-243; E21B047-06

AB US2002038708 A UPAB: 20040128

NOVELTY - Treating a coal formation in situ comprises:

- (1) providing **heat** from at least one **heat** source to at least one part of the formation;
- (2) allowing **heat** to transfer from the **heat** source to a selected section of the formation;
- (3) controlling **heat** from the **heat** source, so that an average temperature within at least a majority of the selected section is less than 375 deg. C; and
- (4) producing a mixture from the formation.

DETAILED DESCRIPTION - INDEPENDENT CLAIMS are also included for the following:

- (1) a method of forming **heater** wells in the coal formation which comprises forming a first wellbore in the formation, forming a second wellbore in the formation using a magnetic tracking, so that the

second wellbore is parallel to the first wellbore and providing at least one **heating** mechanism within the respective wellbores, so that the **heating** mechanisms provide **heat** to at least a portion of the formation;

(2) a system configured to **heat** the coal formation, which comprises a **heater** in an opening in the formation and configured to provide **heat** to at least a portion of the formation during use, an oxidizing fluid source and a conduit in the opening and configured to provide an oxidizing fluid from the oxidizing fluid source to a reaction zone in the formation during use;

in situ production of synthesis **gas** from the coal formation, which comprises **heating** a section of the formation to a temperature to allow synthesis **gas** generation, where a permeability of the section is uniform and greater than the permeability of an unheated section of the formation when the temperature to allow synthesis **gas** generation within the formation is achieved; providing a synthesis **gas** generating fluid (818, 821) to the section to generate synthesis **gas** (823) and removing synthesis **gas** from the formation;

(3) forming a spent portion of the formation within the coal formation, which comprises **heating** a first portion (805) of the formation to pyrolyze hydrocarbons within the first portion and to establish a uniform permeability within the first portion and **cooling** the first portion;

(4) sequestering carbon dioxide (CO<sub>2</sub>) within the coal formation, which comprises **heating** a portion of the formation to increase permeability and form the uniform permeability within the portion, allowing the portion to **cool** and storing CO<sub>2</sub> within the portion;

in situ production of energy from the coal formation, which comprises providing **heat** from the **heat** source(s) to at least a portion of the formation, allowing the **heat** to transfer from the **heat** source(s) to the section of the formation, so that the **heat** from the **heat** source(s) pyrolyzes at least a portion of the hydrocarbons within the section; providing pyrolysis products from the formation; providing at least a portion of the pyrolysis products to a reformer to generate synthesis **gas**, producing the synthesis **gas** from the reformer, providing at least a portion of the produced synthesis **gas** to a **fuel cell** to produce electricity, where the **fuel cell** produces a CO<sub>2</sub> containing exit stream and storing at least a portion of the CO<sub>2</sub> in the CO<sub>2</sub> containing exit stream in a subsurface formation; and

(5) producing ammonia using the coal formation, which comprises separating air to produce oxygen (O<sub>2</sub>) and nitrogen (N<sub>2</sub>) rich streams, **heating** the selected section to a temperature to support reaction of hydrocarbon material in the formation to form synthesis **gas**, providing the synthesis **gas** generating fluid and at least a portion of the O<sub>2</sub> rich stream to the selected section, allowing the synthesis **gas** generating fluid and O<sub>2</sub> in the O<sub>2</sub> rich stream to react with at least a portion of the hydrocarbon material in the formation to generate synthesis **gas**, producing synthesis **gas** from the formation, where the synthesis **gas** comprises hydrogen (H<sub>2</sub>) and carbon monoxide (CO), providing at least a portion of the H<sub>2</sub> in

the synthesis **gas** to an ammonia synthesis process, providing N<sub>2</sub> to the ammonia synthesis process and using the ammonia synthesis process to generate ammonia.

The oxidizing fluid is selected to oxidize at least some hydrocarbons at the reaction zone during use such that **heat** is generated at the reaction zone. The system is configured to allow **heat** to transfer by conduction from the reaction zone to a pyrolysis zone of the formation during use.

**USE** - Used for in situ treatment of a coal formation. It can be used to produce phenol and/or substituted phenols. The **heated** formation may also be used to produce synthesis **gas**.

**ADVANTAGE** - The method economically produces hydrocarbons, hydrogen, and/or other products from coal formations. It reduces energy input costs and electrical energy costs, and significantly enhances economic viability of treating the formation. Pyrolyzing at reduced temperature and increased pressure may decrease an olefin to paraffin ratio in produced fluids. Pyrolyzing coal for a longer time, which may be effected by increasing pressure within the system, result in a lower average molecular weight oil and higher API gravity. Production of **gas** may increase and a non-volatile coke may be formed.

Operating at **high pressure** and a pyrolysis **temperature** at the lower end of the pyrolysis zone decreases the fraction of fluids with carbon numbers greater than 25 produced from the coal. Operating an in situ conversion process at low **pressures** and **high temperatures** may produce a higher quantity of oil liquids than operating at low **temperatures** and **high pressures**. Reducing olefin production reduces coating of a pipe surface by the olefins, reducing the difficulty associated with transporting hydrocarbons through such piping. It may also inhibit polymerization of hydrocarbons during pyrolysis, increasing permeability in the formation and/or enhancing the quality of produced fluids (e.g., by lowering the carbon number distribution, and increasing API gravity). The relatively high, uniform formation permeability allows production wells to be spaced farther apart than production wells used during pyrolysis of the formation.

**DESCRIPTION OF DRAWING(S)** - The figure shows a schematic diagram of using pyrolysis water to generate synthesis **gas** in a formation.

**Heat sources 801**

Electrical **heaters** 803

First portion 805

Pyrolyzation fluid 807

Aqueous stream 811

Synthesis **gas** generating fluid 818, 821

Synthesis **gas** 823

Production well 825

Dwg.29/135

FS CPI EPI GMPI

FA AB; GI; DCN

MC CPI: A01-D13; C05-C01; C05-C06; C05-C08; C14-T03; E05-S; E32-A01; E32-A03;  
H04-E04; H06-B; H09-C

EPI: X27-E01A

L49 ANSWER 25 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
 AN 2002-507184 [54] WPIX  
 CR 2001-648971 [74]; 2002-011222 [01]; 2002-017712 [02]; 2002-017713 [02];  
 2002-017714 [02]; 2002-017715 [02]; 2002-017716 [02]; 2002-026174 [03];  
 2002-026274 [03]; 2002-026277 [03]; 2002-034419 [04]; 2002-062257 [08];  
 2002-267605 [31]; 2002-361205 [39]; 2002-425018 [45]; 2002-425019 [45];  
 2002-425131 [45]; 2002-425269 [45]; 2002-425270 [45]; 2002-425271 [45];  
 2002-425272 [45]; 2002-425308 [45]; 2002-425325 [45]; 2002-425348 [45];  
 2002-433953 [46]; 2002-433954 [46]; 2002-433955 [46]; 2002-442917 [47];  
 2002-443033 [47]; 2002-443034 [47]; 2002-443323 [47]; 2002-443411 [47];  
 2002-453510 [48]; 2002-462626 [49]; 2002-462667 [49]; 2002-478723 [51];  
 2002-478855 [51]; 2002-488664 [52]; 2002-488683 [52]; 2002-488689 [52];  
 2002-488825 [52]; 2002-498950 [53]; 2002-499121 [53]; 2002-526656 [56];  
 2002-526662 [56]; 2002-526663 [56]; 2002-536469 [57]; 2002-536470 [57];  
 2002-536473 [57]; 2002-536493 [57]; 2002-546473 [58]; 2002-546552 [58];  
 2002-556416 [59]; 2002-556417 [59]; 2002-556440 [59]; 2002-556441 [59];  
 2002-556442 [59]; 2002-556443 [59]; 2002-556477 [59]; 2002-556486 [59];  
 2002-556487 [59]; 2002-556488 [59]; 2002-556614 [59]; 2002-565615 [60];  
 2002-565631 [60]; 2002-573643 [61]; 2002-573644 [61]; 2002-582216 [62];  
 2002-589135 [63]; 2002-626390 [67]; 2002-642051 [69]; 2002-705764 [76];  
 2002-730939 [79]; 2002-741241 [80]; 2002-750833 [81]; 2003-045812 [04];  
 2003-045937 [04]; 2003-090588 [08]; 2003-174008 [17]; 2003-247687 [24];  
 2003-340818 [32]; 2003-354033 [33]; 2003-391555 [37]; 2003-416423 [39];  
 2003-456902 [43]; 2003-456904 [43]; 2003-481056 [45]; 2003-492660 [46];  
 2003-492839 [46]; 2003-531449 [50]; 2003-554765 [52]; 2003-576140 [54];  
 2003-778317 [73]; 2003-778318 [73]; 2003-786795 [74]; 2003-851506 [79];  
 2004-041710 [04]; 2004-068762 [07]  
 DNN N2002-401336 DNC C2002-144129  
 TI Method of treating coal formation in situ, involves transferring  
 heat to selected section of coal formation and controlling  
 heat from heat sources, so as to produce mixture from  
 the formation.  
 DC A41 C04 E16 E17 E35 E36 H01 H04 H06 H09 Q49 X11 X16  
 IN BERCHENKO, I E; DE ROUFFIGNAC, E P; FOWLER, T D; KARANIKAS, J M; MAHER, K  
 A; RYAN, R C; STEGEMEIER, G L; VINEGAR, H J; WELLINGTON, S L; ZHANG, E  
 PA (BERC-I) BERCHENKO I E; (DROU-I) DE ROUFFIGNAC E P; (FOWL-I) FOWLER T D;  
 (KARA-I) KARANIKAS J M; (MAHE-I) MAHER K A; (RYAN-I) RYAN R C; (STEG-I)  
 STEGEMEIER G L; (VINE-I) VINEGAR H J; (WELL-I) WELLINGTON S L; (ZHAN-I)  
 ZHANG E; (SHEL) SHELL OIL CO  
 CYC 1  
 PI US 2002038706 A1 20020404 (200254)\* 372p E21B036-02  
 US 6591907 B2 20030715 (200354) E21B043-24  
 ADT US 2002038706 A1 Provisional US 2000-199213P 20000424, Provisional US  
 2000-199214P 20000424, Provisional US 2000-199215P 20000424, US  
 2001-841500 20010424; US 6591907 B2 Provisional US 2000-199213P 20000424,  
 Provisional US 2000-199214P 20000424, Provisional US 2000-199215P  
 20000424, US 2001-841500 20010424  
 PRAI US 2001-841500 20010424; US 2000-199213P 20000424; US 2000-199214P  
 20000424; US 2000-199215P 20000424  
 IC ICM E21B036-02; E21B043-24  
 ICS E21B043-243  
 AB US2002038706 A UPAB: 20040128

NOVELTY - Treatment of coal formation in situ comprises transfer of **heat** from **heat** source(s) (801) to a selected section of the formation. **Heat** from the sources is controlled, such that an average temperature within at least a majority of the selected section of the formation, is less than 375 deg. C, and a mixture is produced from the formation.

DETAILED DESCRIPTION - INDEPENDENT CLAIMS are included for the following:

- (1) In situ method for **heating** coal formation with an oxidizing fluid;
- (2) In situ method for producing hydrogen from coal formation, where hydrogen partial pressure within the mixture is greater than 0.5 bar;
- (3) Method for forming **heater** wells in coal formation which involves forming well bore using magnetic tracking and providing **heating** mechanism within the well bore;
- (4) Method for installing **heater** well into coal formation;
- (5) System configured to **heat** coal formation;
- (6) Mixture produced from portion of coal formation which comprises olefin content and average carbon number less than 35;
- (7) Method for in situ production of synthesis **gas** (823) from coal formation;
- (8) Method for forming spent portion of formation within coal formation;
- (9) Method of sequestering carbon dioxide within coal formation;
- (10) Method of in situ production of energy from coal formation;
- (11) Method for producing ammonia using coal formation; and
- (12) Method for treating hydrocarbons in at least a portion of coal formation.

USE - For producing hydrogen; synthesis **gas**, carbon dioxide, energy and ammonia used for fertilizer (all claimed). The synthesis **gas** is **combusted** as fuel and is used to generate electricity, to make steam to run turbines and also in energy generation units like molten carbonate **fuel cell**, solid oxide **fuel cell** or other types of **fuel cells**. Carbon dioxide obtained from the formation is stored in deep cold beds, used to desorb coal bed methane. The spent portion of the coal formation is used to store and/or sequester other materials such as carbon dioxide.

ADVANTAGE - A mixture of relatively high quality hydrocarbon products, hydrogen and other products is obtained. **High temperature** pumping of liquids from production well is reduced or eliminated, which decreases production cost. **Heat** provided through the production well prevents **condensation** and/or refluxing of production fluid, increases **heat** input into the formation and/or increases formation permeability at or proximate the production well. Since permeability and/or porosity increases in the **heated** formation, produced vapors flow considerable distances through the formation with relatively little pressure differential. The hydrocarbons are pyrolyzed within a larger area of portion using fewer **heat** sources, as spacing between the **heat** sources is selected to increase the effectiveness of the **heat** source, thereby economic viability of selected in situ conversion process for

hydrocarbon is increased. Uniformity of heat distribution in selected section of the formation is increased. The pressure of hydrogen in produced fluid is controlled, such that large amount of fluids having improved quality is provided.

DESCRIPTION OF DRAWING(S) - The figure shows the schematic diagram of using pyrolysis water to generate synthesis gas in a formation.

Heat source 801

Synthesis gas 823

Dwg.29/135

FS CPI EPI GMPI

FA AB; GI; DCN

MC CPI: A01-D13; C05-C01; C05-C06; C05-C08; C10-E04D; C14-T03; E05-S;  
E10-E04E1; E32-A01; E32-A03; H01-D08; H04-E04; H04-E06; H06-A03;  
H09-D

EPI: X11-A09; X16-C01A; X16-C02; X16-C15

L49 ANSWER 26 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

AN 2002-478748 [51] WPIX

DNN N2002-378045 DNC C2002-136155

TI Chemical composition for use as electrode and electrolyte materials in devices, e.g. batteries, and for hydrogen production, includes transition metal compounds, aluminum, and soluble bases or electrolytes.

DC E36 L03 V01 X16

IN SCHMIDT, D G

PA (SCHM-I) SCHMIDT D G; (MILL-N) MILLENIUM ENERGY LLC

CYC 94

PI US 2002037452 A1 20020328 (200251)\* 19p H01M004-46

WO 2002052664 A2 20020704 (200251) EN H01M004-02

RW: AT BE CH CY DE DK EA ES FI FR GB GH GM GR IE IT KE LS LU MC MW MZ  
NL OA PT SD SE SL SZ TR TZ UG ZW

W: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CR CU CZ DE DK DM  
DZ EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC  
LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PL PT RO RU SD SE  
SG SI SK SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW

ADT US 2002037452 A1 Provisional US 2000-213395P 20000623, US 2001-887531  
20010622; WO 2002052664 A2 WO 2001-US20159 20010622

PRAI US 2000-213395P 20000623; US 2001-887531 20010622

IC ICM H01M004-02; H01M004-46

ICS C01B003-02; C01B003-08; C22C021-00; H01G009-00; H01G009-35;  
H01G009-45; H01M004-36; H01M004-58; H01M004-62; H01M008-06;  
H01M008-08; H01M010-26; H01M012-06

AB US2002037452 A UPAB: 20020812

NOVELTY - Chemical composition comprises transition metal compound(s), aluminum and a solution comprising base(s) or electrolyte(s).

DETAILED DESCRIPTION - INDEPENDENT CLAIMS are also included for:

(1) a method of producing hydrogen gas comprising providing a composition where the base is in aqueous solution; and contacting it with aluminum;

(2) a method of manufacturing the alloy comprising aluminum and high electron mobility component(s), by mixing the ingredients and cooling until solidification;

(3) a battery comprising an anode, a cathode and an electrolyte;



(4) a capacitor comprising an anode in contact with a sample of carbon foam, a cathode, an electrolyte, and a dielectric;

(5) a **fuel cell** comprising an anode, cathode, and an electrolyte; and

(6) a **fuel cell** assembly comprising a hydrogen **fuel cell** and a hydrogen generator comprising the new composition and water.

In (3)-(5), the anode and electrolyte comprise the new composition.

USE - The composition is used as electrode and electrolyte materials in devices, e.g. batteries, capacitors, **fuel cells** and hybrid battery/**fuel cell** designs. It can also be used in direct production of hydrogen **gas** for internal **combustion** engines, **heating**, ion propulsion, magnetohydrodynamics, **fuel cells**, welding, hydrogenation of oils, hydrogenation of petroleum and petrochemical fuels, hydrogenation of polymer related materials, reduction of organic compounds, reduction of inorganic and organometallic compounds, hydrogenation of volatile materials in vapor deposition processes, conventional jet propulsion, rocket fuel, and other applications.

ADVANTAGE - The composition exceeds the performance capabilities of those currently used in devices, e.g. batteries, capacitors, and **fuel cells**. It provides a capacitor with a greater energy density and more potential applications than currently available with conventional capacitor systems. It releases hydrogen and energy over time, e.g. a period of a few hours to weeks when contacted with water. It does not need to generate hydrogen as in known electrolysis systems, liberates hydrogen **gas** more efficiently than conventional metal hydride storage systems, and hydrogen **gas** is generated when needed and not stored under **high pressure** in compressed **gas** tanks. The alloy electrodes are less expensive than the platinum or platinum alloy electrodes of conventional hydrogen **fuel cells**.

DESCRIPTION OF DRAWING(S) - The figure shows hydrogen production from the new composition compared to hydrogen production from the same composition without nickel hydroxide.

Dwg.1/1

FS CPI EPI

FA AB; GI; DCN

MC CPI: E11-S; E31-A02; L03-B03A; L03-E01C

EPI: V01-B01A; X16-B01A; X16-E01; X16-E01C; X16-E09

L49 ANSWER 27 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

AN 2002-478723 [51] WPIX

CR 2001-648971 [74]; 2002-011222 [01]; 2002-017712 [02]; 2002-017713 [02];  
2002-017714 [02]; 2002-017715 [02]; 2002-017716 [02]; 2002-026174 [03];  
2002-026274 [03]; 2002-026277 [03]; 2002-034419 [04]; 2002-062257 [08];  
2002-267605 [31]; 2002-361205 [39]; 2002-425018 [45]; 2002-425019 [45];  
2002-425131 [45]; 2002-425269 [45]; 2002-425270 [45]; 2002-425271 [45];  
2002-425272 [45]; 2002-425308 [45]; 2002-425325 [45]; 2002-425348 [45];  
2002-433953 [46]; 2002-433954 [46]; 2002-433955 [46]; 2002-442917 [47];  
2002-443033 [47]; 2002-443034 [47]; 2002-443323 [47]; 2002-443411 [47];  
2002-453510 [48]; 2002-462626 [49]; 2002-462667 [49]; 2002-478855 [51];

2002-488664 [52]; 2002-488683 [52]; 2002-488689 [52]; 2002-488825 [52];  
 2002-498950 [53]; 2002-499121 [53]; 2002-507184 [54]; 2002-526656 [56];  
 2002-526662 [56]; 2002-526663 [56]; 2002-536469 [57]; 2002-536470 [57];  
 2002-536473 [57]; 2002-536493 [57]; 2002-546473 [58]; 2002-546552 [58];  
 2002-556416 [59]; 2002-556417 [59]; 2002-556440 [59]; 2002-556441 [59];  
 2002-556442 [59]; 2002-556443 [59]; 2002-556477 [59]; 2002-556486 [59];  
 2002-556487 [59]; 2002-556488 [59]; 2002-556614 [59]; 2002-565615 [60];  
 2002-565631 [60]; 2002-573643 [61]; 2002-573644 [61]; 2002-582216 [62];  
 2002-589135 [63]; 2002-626390 [67]; 2002-642051 [69]; 2002-705764 [76];  
 2002-730939 [79]; 2002-741241 [80]; 2002-750833 [81]; 2003-045812 [04];  
 2003-045937 [04]; 2003-090588 [08]; 2003-174008 [17]; 2003-247687 [24];  
 2003-340818 [32]; 2003-354033 [33]; 2003-391555 [37]; 2003-416423 [39];  
 2003-456902 [43]; 2003-456904 [43]; 2003-481056 [45]; 2003-492660 [46];  
 2003-492839 [46]; 2003-531449 [50]; 2003-554765 [52]; 2003-576140 [54];  
 2003-778317 [73]; 2003-778318 [73]; 2003-786795 [74]; 2003-851506 [79];  
 2004-041710 [04]; 2004-068762 [07]

DNN N2002-378024 DNC C2002-136147

TI In situ treatment of hydrocarbon containing formation, e.g. coal formation, involves controlled **heating** of selected section of formation at specified temperature.

DC A41 C04 E16 E17 E35 E36 H01 H04 H06 H09 Q49

IN BERCHENKO, I E; ROUFFIGNAC, E P D; VINEGAR, H J; WELLINGTON, S L

PA (BERC-I) BERCHENKO I E; (ROUF-I) ROUFFIGNAC E P D; (VINE-I) VINEGAR H J; (WELL-I) WELLINGTON S L

CYC 1

PI US 2002036084 A1 20020328 (200251)\* 461p E21B043-24

ADT US 2002036084 A1 Provisional US 2000-199213P 20000424, Provisional US 2000-199214P 20000424, Provisional US 2000-199215P 20000424, US 2001-841635 20010424

PRAI US 2001-841635 20010424; US 2000-199213P 20000424; US 2000-199214P 20000424; US 2000-199215P 20000424

IC ICM E21B043-24

AB US2002036084 A UPAB: 20040128

NOVELTY - A hydrocarbon containing formation is treated in situ by providing a portion of the formation with **heat** from **heat** source(s) (801), and allowing **heat** to transfer to a selected section (805) of the formation. The **heat** from the **heat** source(s) is controlled such that an average temperature within the selected section is less than 375 deg. C. A mixture is then produced from the formation.

DETAILED DESCRIPTION - INDEPENDENT CLAIMS are also included for:

(1) an in situ method for producing H2 from a hydrocarbon containing formation comprising:

(1) transferring **heat** from the **heat** sources to a portion of the formation; and

(2) producing a mixture from the formation in which a hydrogen partial pressure within the mixture is greater than 0.5 bar;

(2) a method of installing a **heater** well into a hydrocarbon containing formation comprising:

(1) forming a bore in the ground using a steerable motor and an accelerometer; and

(2) providing a **heating** mechanism within the bore such that

the **heating** mechanism can transfer **heat** to a portion of the formation;

(3) a system for **heating** a hydrocarbon containing formation comprising:

- (1) a **heater** disposed in an opening in the formation;
- (2) an oxidizing fluid source; and

(3) a conduit disposed in the opening for providing an oxidizing fluid from the oxidizing fluid source to a reaction zone in the formation during use;

(4) an in situ method for **heating** a hydrocarbon containing formation comprising:

(1) **heating** a portion of the formation to a predetermined temperature to support reaction of hydrocarbons within the portion of the formation with an oxidizing fluid;

(2) providing the oxidizing fluid to a reaction zone in the formation;

(3) allowing the oxidizing fluid to react with the portion of the hydrocarbons at the reaction zone to generate **heat** at the reaction zone; and

(4) transferring the generated **heat** by conduction from the reaction zone to a pyrolysis zone in the formation;

(5) a composition produced from a portion of a hydrocarbon containing formation, comprising:

- (1) less than 10 weight% olefin; and
- (2) less than 35 average carbon number;

(6) a method for in situ production of synthesis **gas** (823) from a hydrocarbon containing formation comprising:

(1) **heating** a section of the formation to a certain temperature to allow synthesis **gas** generation;

(2) providing a synthesis **gas** generating fluid (821) to the section to generate synthesis **gas**; and

(3) removing synthesis **gas** from the formation;

(7) a method for in situ production of energy from a hydrocarbon containing formation comprising:

(1) providing **heat** from **heat** sources to a portion of the formation;

(2) allowing the **heat** to transfer from the **heat** sources to a selected section of the formation;

(3) producing pyrolysis products from the formation;

(4) providing a portion of the pyrolysis products to a reformer to generate synthesis **gas**;

(5) producing the synthesis **gas** from the reformer;

(6) providing a portion of the produced synthesis **gas** to a fuel cell to produce electricity; and

(7) storing a portion of the carbon dioxide in the carbon dioxide containing exit stream in a subsurface formation; and

(8) a method of forming a spent portion of formation within a hydrocarbon containing formation, comprising:

(1) heating a first portion of the formation to pyrolyze hydrocarbons within the first portion and to establish a substantially uniform permeability within the first portion; and

(2) cooling the first portion.

(9) a method of sequestering carbon dioxide within the coal formation involving heating a portion of the formation to increase permeability and form uniform permeability within the portion, allowing the portion to cool, and storing carbon dioxide within the portion

(10) a method for producing ammonia using a carbon containing formation comprising:

(1) separating air to produce an oxygen-rich stream and a nitrogen-rich stream;

(2) heating a selected section of the formation to a predetermined temperature to support reaction of carbon-containing material in the formation to form synthesis gas;

(3) providing synthesis gas generating fluid and a portion of the oxygen rich stream to the selected section;

(4) allowing the synthesis gas generating fluid and oxygen in the oxygen-rich stream to react with a portion of the carbon-containing material in the formation to generate synthesis gas;

(5) producing synthesis gas from the formation, in which the synthesis gas comprises hydrogen and carbon monoxide;

(6) providing a portion of the hydrogen in the synthesis gas to an ammonia synthesis process;

(7) providing nitrogen to the ammonia synthesis process; and

(8) using the ammonia synthesis process to generate ammonia.

USE - The method is for in situ treatment of hydrocarbon containing formation, (e.g., a formation containing coal including lignite or sapropelic coal, oil shale, carbonaceous shale, shungites, kerogen, oil, kerogen and oil in low permeability matrix, heavy hydrocarbons, asphaltites, or natural waxes formation) to produce a mixture of hydrocarbons, hydrogen, and other formation fluids. The treated formation may be used to generate synthesis gas. The synthesis gas is used in Fischer-Tropsch hydrocarbon synthesis process to produce paraffins; in catalytic methanation process to produce methane; and in producing methanol, gasoline and diesel fuel, ammonia, and middle distillates. It can also be used as a combustion fuel for heating the formation; and in energy generation unit (e.g., molten carbonate fuel cell or solid oxide fuel cell).

ADVANTAGE - The inventive method economically produces high quality hydrocarbon products, hydrogen and/or other formation products. It forms a uniform, high permeability formation. The superposition of heat increases the uniformity of heat distribution in the section of the formation.

DESCRIPTION OF DRAWING(S) - The figure shows the method of generating synthesis gas from the treated hydrocarbon containing formation using pyrolysis water.

Heat source 801

Electrical heater 803

Section of the formation 805, 819

Synthesis gas generating fluid 821

Synthesis gas 823

Dwg. 29/182

FS CPI GMPI

FA AB; GI; DCN

MC CPI: A01-D13; C05-C01; C05-C06; C05-C08; C10-E04D; C14-T03; E05-S;

E10-E04E1; E32-A01; E32-A03; H01-C; H01-D08; H04-E04; H06-B; H09-A01A

L49 ANSWER 28 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN  
 AN 2002-546473 [58] WPIX  
 CR 2001-648971 [74]; 2002-011222 [01]; 2002-017712 [02]; 2002-017713 [02];  
 2002-017714 [02]; 2002-017715 [02]; 2002-017716 [02]; 2002-026174 [03];  
 2002-026274 [03]; 2002-026277 [03]; 2002-034419 [04]; 2002-062257 [08];  
 2002-267605 [31]; 2002-361205 [39]; 2002-425018 [45]; 2002-425019 [45];  
 2002-425131 [45]; 2002-425269 [45]; 2002-425270 [45]; 2002-425271 [45];  
 2002-425272 [45]; 2002-425308 [45]; 2002-425325 [45]; 2002-425348 [45];  
 2002-433953 [46]; 2002-433954 [46]; 2002-433955 [46]; 2002-442917 [47];  
 2002-443033 [47]; 2002-443034 [47]; 2002-443323 [47]; 2002-443411 [47];  
 2002-453510 [48]; 2002-462626 [49]; 2002-462667 [49]; 2002-478723 [51];  
 2002-478855 [51]; 2002-488664 [52]; 2002-488683 [52]; 2002-488689 [52];  
 2002-488825 [52]; 2002-498950 [53]; 2002-499121 [53]; 2002-507184 [54];  
 2002-526656 [56]; 2002-526662 [56]; 2002-526663 [56]; 2002-536469 [57];  
 2002-536470 [57]; 2002-536473 [57]; 2002-536493 [57]; 2002-546552 [58];  
 2002-556416 [59]; 2002-556417 [59]; 2002-556440 [59]; 2002-556441 [59];  
 2002-556442 [59]; 2002-556443 [59]; 2002-556477 [59]; 2002-556486 [59];  
 2002-556487 [59]; 2002-556488 [59]; 2002-556614 [59]; 2002-565615 [60];  
 2002-565631 [60]; 2002-573643 [61]; 2002-573644 [61]; 2002-582216 [62];  
 2002-589135 [63]; 2002-626390 [67]; 2002-642051 [69]; 2002-705764 [76];  
 2002-730939 [79]; 2002-741241 [80]; 2002-750833 [81]; 2003-045812 [04];  
 2003-045937 [04]; 2003-090588 [08]; 2003-174008 [17]; 2003-247687 [24];  
 2003-340818 [32]; 2003-354033 [33]; 2003-391555 [37]; 2003-416423 [39];  
 2003-456902 [43]; 2003-456904 [43]; 2003-481056 [45]; 2003-492660 [46];  
 2003-492839 [46]; 2003-531449 [50]; 2003-554765 [52]; 2003-576140 [54];  
 2003-778317 [73]; 2003-778318 [73]; 2003-786795 [74]; 2003-851506 [79];  
 2004-041710 [04]; 2004-068762 [07]  
 DNN N2002-432542 DNC C2002-154902  
 TI Method of treating coal formation in situ for production of synthesis  
**gas**, involves transferring **heat** to selected portion of  
 formation and controlling **heat** to attain specific mean  
 temperature of formation.  
 DC A41 C04 E16 E17 E35 E36 H01 H04 H06 H09 X16  
 IN BERCHENKO, I E; DE ROUFFIGNAC, E P; FOWLER, T D; KARANIKAS, J M; MAHER, K  
 A; RYAN, R C; STEGEMEIER, G L; VINEGAR, H J; WELLINGTON, S L; ZHANG, E  
 PA (BERC-I) BERCHENKO I E; (DROU-I) DE ROUFFIGNAC E P; (FOWL-I) FOWLER T D;  
 (KARA-I) KARANIKAS J M; (MAHE-I) MAHER K A; (RYAN-I) RYAN R C; (STEG-I)  
 STEGEMEIER G L; (VINE-I) VINEGAR H J; (WELL-I) WELLINGTON S L; (ZHAN-I)  
 ZHANG E  
 CYC 1  
 PI US 2002034380 A1 20020321 (200258)\* 371p C01B003-24  
 ADT US 2002034380 A1 Provisional US 2000-199213P 20000424, Provisional US  
 2000-199214P 20000424, Provisional US 2000-199215P 20000424, US  
 2001-841442 20010424  
 PRAI US 2001-841442 20010424; US 2000-199213P 20000424; US 2000-199214P  
 20000424; US 2000-199215P 20000424  
 IC ICM C01B003-24  
 AB US2002034380 A UPAB: 20040128  
 NOVELTY - A portion of coal formation is **heated** using  
**heat** source(s) (801). The **heat** is then transferred from  
**heat** source(s) to a selected section of formation. The

heat from heat source(s) is controlled such that average temperature within majority of selected section of formation is less than 375 deg. C. Finally, a mixture is produced from the formation.

DETAILED DESCRIPTION - INDEPENDENT CLAIMS are also included for the following:

- (1) In situ method for **heating** coal formation;
- (2) In situ method for producing hydrogen from coal formation;
- (3) Method for forming **heater** wells in coal formation;
- (4) System configured to **heat** coal formation;
- (5) Mixture produced from a portion of coal formation;
- (6) In situ production of synthesis **gas** from coal formation;
- (7) Method of forming a spent portion of formation within coal formation;
- (8) Method of sequestering carbon dioxide within coal formation;
- (9) In situ production of energy from coal formation;
- (10) Production of ammonia using coal formation;
- (11) Treatment of hydrocarbons in at least a portion of coal formation.

USE - For **heating** coal formation including humic and/or sapropelic coal used for production of hydrocarbons, hydrogen and/or other products from coal formation. For production of synthesis **gas** used in the production of other products such as diesel, jet fuel, naphtha products, methane by catalytic methylation process, methanol, gasoline and diesel fuel, ammonia (for fertilizers) and middle distillates. For synthesizing a wide range of organic and/or inorganic compounds such as hydrocarbons and ammonia. For generating electricity by **combusting** it as a fuel, by reducing the pressure of synthesis **gas** in turbines and/or using the temperature of synthesis **gas** to make steam. For energy generation unit such as molten carbonate **fuel cell**, solid oxide **fuel cell** or other type of **fuel cell**. Carbon dioxide in synthesis **gas** produced from coal formation, is used for synthesis **gas** production and/or coal bed methane production.

ADVANTAGE - The coal formations are treated to yield relatively high quality hydrocarbon products, hydrogen, and other products. **Cooling** of formation increases the strength of rock in the formation (thereby mitigating subsidence) and increases absorptive capacity of the formation. The in situ treatment of coal formation increases transfer of vapors through the treated portion of the formation. Therefore, a number of production wells required to produce a mixture from the formation may be reduced, thereby increasing economic viability of in situ conversion process. **High temperature** pumping of liquids from the production well is reduced or eliminated, which decreases production cost. **Heating** the production well prevents **condensation** and/or refluxing of production fluid, increases **heat** input into formation and increases formation permeability at or proximate the production well. By maintaining increased pressure within the formation facilitates production of formation fluids, facilitates generation of electricity from produced non-**condensable** fluid, and reduces or eliminates the need to compress formation fluid at a surface because the formation products are produced at higher pressure.

DESCRIPTION OF DRAWING(S) - The figure shows the generation of synthesis **gas** formation using pyrolysis water.

Heat source(s) 801

Production well 825

Dwg.29/135

FS CPI EPI

FA AB; GI; DCN

MC CPI: A01-D13; C05-C01; C05-C04; C05-C08; C10-J02; E10-J02D1; E31-A01; E31-A02; E31-N05B; E31-N05C; E32-A01; H01-D08; H04-E04; H04-E06; H06-A03; H06-B01; H06-B03; H06-B04; H09-C  
EPI: X16-C01A; X16-C02; X16-C15

L49 ANSWER 29 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

AN 2002-443034 [47] WPIX

CR 2001-648971 [74]; 2002-011222 [01]; 2002-017712 [02]; 2002-017713 [02]; 2002-017714 [02]; 2002-017715 [02]; 2002-017716 [02]; 2002-026174 [03]; 2002-026274 [03]; 2002-026277 [03]; 2002-034419 [04]; 2002-062257 [08]; 2002-267605 [31]; 2002-361205 [39]; 2002-425018 [45]; 2002-425019 [45]; 2002-425131 [45]; 2002-425269 [45]; 2002-425270 [45]; 2002-425271 [45]; 2002-425272 [45]; 2002-425308 [45]; 2002-425325 [45]; 2002-425348 [45]; 2002-433953 [46]; 2002-433954 [46]; 2002-433955 [46]; 2002-442917 [47]; 2002-443033 [47]; 2002-443323 [47]; 2002-443411 [47]; 2002-453510 [48]; 2002-462626 [49]; 2002-462667 [49]; 2002-478723 [51]; 2002-478855 [51]; 2002-488664 [52]; 2002-488683 [52]; 2002-488689 [52]; 2002-488825 [52]; 2002-498950 [53]; 2002-499121 [53]; 2002-507184 [54]; 2002-526656 [56]; 2002-526662 [56]; 2002-526663 [56]; 2002-536469 [57]; 2002-536470 [57]; 2002-536473 [57]; 2002-536493 [57]; 2002-546473 [58]; 2002-546552 [58]; 2002-556416 [59]; 2002-556417 [59]; 2002-556440 [59]; 2002-556441 [59]; 2002-556442 [59]; 2002-556443 [59]; 2002-556477 [59]; 2002-556486 [59]; 2002-556487 [59]; 2002-556488 [59]; 2002-556614 [59]; 2002-565615 [60]; 2002-565631 [60]; 2002-573643 [61]; 2002-573644 [61]; 2002-582216 [62]; 2002-589135 [63]; 2002-626390 [67]; 2002-642051 [69]; 2002-705764 [76]; 2002-730939 [79]; 2002-741241 [80]; 2002-750833 [81]; 2003-045812 [04]; 2003-045937 [04]; 2003-090588 [08]; 2003-174008 [17]; 2003-247687 [24]; 2003-340818 [32]; 2003-354033 [33]; 2003-391555 [37]; 2003-416423 [39]; 2003-456902 [43]; 2003-456904 [43]; 2003-481056 [45]; 2003-492660 [46]; 2003-492839 [46]; 2003-531449 [50]; 2003-554765 [52]; 2003-576140 [54]; 2003-778317 [73]; 2003-778318 [73]; 2003-786795 [74]; 2003-851506 [79]; 2004-041710 [04]; 2004-068762 [07]

DNN N2002-348980 DNC C2002-126082

TI In situ treatment of coal formation by providing **heat** to at least one portion of the formation, allowing **heat** to transfer from **heat** sources to selected section of formation and producing mixture from formation.

DC A41 C04 E16 E17 E35 E36 H01 H04 H06 H09 Q49

IN BAXLEY, P T; BERCHENKO, I E; DE ROUFFIGNAC, E P; KARANIKAS, J M; MAHER, K A; SCHOELING, L G; STEGEMEIER, G L; VINEGAR, H J; WELLINGTON, S L; ZHANG, E

PA (BAXL-I) BAXLEY P T; (BERC-I) BERCHENKO I E; (DROU-I) DE ROUFFIGNAC E P; (KARA-I) KARANIKAS J M; (MAHE-I) MAHER K A; (SCHO-I) SCHOELING L G; (STEG-I) STEGEMEIER G L; (VINE-I) VINEGAR H J; (WELL-I) WELLINGTON S L; (ZHAN-I) ZHANG E

CYC 1

PI US 2002033280 A1 20020321 (200247)\* 371p E21B007-06

ADT US 2002033280 A1 Provisional US 2000-199213P 20000424, Provisional US 2000-199214P 20000424, Provisional US 2000-199215P 20000424, US 2001-841501 20010424

PRAI US 2001-841501 20010424; US 2000-199213P 20000424; US 2000-199214P 20000424; US 2000-199215P 20000424

IC ICM E21B007-06

AB US2002033280 A UPAB: 20040128

NOVELTY - In situ treatment of coal formation comprises: providing **heat** from at least one **heat** source (801) to at least one portion of the formation, allowing the **heat** to transfer from the **heat** sources to selected section of the formation, and producing a mixture from the formation. The **heat** sources are within at least one open wellbore in the formation.

DETAILED DESCRIPTION - INDEPENDENT CLAIMS are also included for the following:

(A) forming **heater** wells in a coal formation, which comprises forming a first wellbore in the formation, forming a second wellbore in the formation using magnetic tracking such that the second wellbore is arranged parallel to the first wellbore, and providing at least one **heating** mechanism within the first wellbore and at least one **heating** mechanism within the second wellbore such that the **heating** mechanisms can provide **heat** to at least a portion of the formation;

(B) a system configured to **heat** a coal formation, which comprises a **heater** in an opening in the formation and configured to provide **heat** to at least a portion of the formation during use, an oxidizing fluid source and a conduit disposed in the opening and configured to provide an oxidizing fluid from the source to a reaction zone in the formation during use, where the oxidizing fluid is selected to oxidize at least some hydrocarbons at the reaction zone during use such that **heat** is generated at the reaction zone, and where the system is configured to allow **heat** to transfer by conduction from the reaction zone to a pyrolysis zone of the formation during use;

in situ production of synthesis **gas** from a coal formation, which comprises **heating** a section of the formation to a temperature to allow synthesis **gas** generation, where permeability of the section is uniform and greater than a permeability of an unheated section of the formation when the temperature to allow synthesis **gas** generation within the formation is achieved; providing a synthesis **gas** generating fluid (818, 821) to the section to generate synthesis **gas**; and removing synthesis **gas** (823) from the formation;

(C) forming a spent portion of formation within a coal formation, which comprises **heating** a first portion (805) of the formation to pyrolyze hydrocarbons within the first portion and to establish a uniform permeability within the first portion, and **cooling** the first portion;

(D) sequestering carbon dioxide within a coal formation, which comprises **heating** a portion of the formation to increase permeability and form a uniform permeability within the portion, allowing



the portion to cool, and storing carbon dioxide within the portion; and

(E) producing ammonia using a coal formation, which comprises separating air to produce an oxygen (O<sub>2</sub>) rich stream and a nitrogen (N<sub>2</sub>) rich stream; **heating** a selected section of the formation to a temperature to support reaction of hydrocarbon material in the formation to form synthesis **gas**; providing synthesis **gas** generating fluid and at least a portion of the O<sub>2</sub> rich stream to the selected section; allowing the synthesis **gas** generating fluid and O<sub>2</sub> in the O<sub>2</sub> rich stream to react with at least a portion of the hydrocarbon material in the formation to generate synthesis **gas**; producing synthesis **gas** comprising H<sub>2</sub> and carbon monoxide (CO) from the formation; providing at least a portion of the H<sub>2</sub> in the synthesis **gas** to an ammonia synthesis process; providing N<sub>2</sub> to the ammonia synthesis process; and using ammonia synthesis process to generate ammonia.

USE - The method is used for treating a coal formation in situ. It is used for producing a mixture of hydrocarbon products, hydrogen, and other products from various coal formations. It is useful for producing synthesis **gas**, carbon dioxide, and ammonia (claimed). The hydrocarbons produced are used as energy resources, feedstocks, and as consumer products.

ADVANTAGE - The method economically produces high quality hydrocarbons, hydrogen, and other products from various coal formations. Sequestering fluid within the formation reduces or eliminates fluid that is released to the environment due to operation of the in situ conversion process. The method reduces energy input costs, and the oxidation reaction may be propagated slowly through a greater portion of the formation so that fewer **heat** sources may be required to **heat** such a greater portion in comparison to **heating** by a conventional method. The uniform permeability provides high recovery of synthesis **gas** as compared to synthesis **gas** generation in a coal formation that has not been so treated.

**Cooling** of the formation increases the strength of the rock in the formation, thus mitigating subsidence, and increases absorptive capacity of the formation. The method reduces or eliminates **high temperature** pumping of liquids from the production well, which in turn decreases production costs. **Heating** at or through the production well prevents **condensation** and/or refluxing of production fluid when it is moving in the production well near the overburden, increases **heat** input into the formation, and/or increases formation permeability at or near the production well.

DESCRIPTION OF DRAWING(S) - The drawing is a schematic diagram of using pyrolysis water to generate synthesis **gas** in a formation.

Heat source 801

Electric heater 803

First section of the formation 805

Produced pyrolysis fluid 807

Aqueous stream 811

Vapor stream 813

Synthesis **gas** generating fluid 818, 821

Synthesis **gas** 823

Synthesis gas production well 825

Dwg.29/135

FS CPI GMPI

FA AB; GI; DCN

MC CPI: A01-D13; C05-C01; C05-C06; C05-C08; C14-T03; E05-S; E32-A01; H01-D08;  
H04-E04; H04-E05; H04-E06; H06-A03; H09-C

L49 ANSWER 30 OF 84 WPIX COPYRIGHT 2004 THOMSON DERWENT on STN

AN 2002-433955 [46] WPIX

CR 2001-648971 [74]; 2002-011222 [01]; 2002-017712 [02]; 2002-017713 [02];  
2002-017714 [02]; 2002-017715 [02]; 2002-017716 [02]; 2002-026174 [03];  
2002-026274 [03]; 2002-026277 [03]; 2002-034419 [04]; 2002-062257 [08];  
2002-267605 [31]; 2002-361205 [39]; 2002-425018 [45]; 2002-425019 [45];  
2002-425131 [45]; 2002-425269 [45]; 2002-425270 [45]; 2002-425271 [45];  
2002-425272 [45]; 2002-425308 [45]; 2002-425325 [45]; 2002-425348 [45];  
2002-433953 [46]; 2002-433954 [46]; 2002-442917 [47]; 2002-443033 [47];  
2002-443034 [47]; 2002-443323 [47]; 2002-443411 [47]; 2002-453510 [48];  
2002-462626 [49]; 2002-462667 [49]; 2002-478723 [51]; 2002-478855 [51];  
2002-488664 [52]; 2002-488683 [52]; 2002-488689 [52]; 2002-488825 [52];  
2002-498950 [53]; 2002-499121 [53]; 2002-507184 [54]; 2002-526656 [56];  
2002-526662 [56]; 2002-526663 [56]; 2002-536469 [57]; 2002-536470 [57];  
2002-536473 [57]; 2002-536493 [57]; 2002-546473 [58]; 2002-546552 [58];  
2002-556416 [59]; 2002-556417 [59]; 2002-556440 [59]; 2002-556441 [59];  
2002-556442 [59]; 2002-556443 [59]; 2002-556477 [59]; 2002-556486 [59];  
2002-556487 [59]; 2002-556488 [59]; 2002-556614 [59]; 2002-565615 [60];  
2002-565631 [60]; 2002-573643 [61]; 2002-573644 [61]; 2002-582216 [62];  
2002-589135 [63]; 2002-626390 [67]; 2002-642051 [69]; 2002-705764 [76];  
2002-730939 [79]; 2002-741241 [80]; 2002-750833 [81]; 2003-045812 [04];  
2003-045937 [04]; 2003-090588 [08]; 2003-174008 [17]; 2003-247687 [24];  
2003-340818 [32]; 2003-354033 [33]; 2003-391555 [37]; 2003-416423 [39];  
2003-456902 [43]; 2003-456904 [43]; 2003-481056 [45]; 2003-492660 [46];  
2003-492839 [46]; 2003-531449 [50]; 2003-554765 [52]; 2003-576140 [54];  
2003-778317 [73]; 2003-778318 [73]; 2003-786795 [74]; 2003-851506 [79];  
2004-041710 [04]; 2004-068762 [07]

DNN N2002-341486 DNC C2002-123273

TI Method of treating coal formation in situ for production of synthesis  
gas, involves transferring heat to selected portion of  
formation and controlling heat to attain specific mean  
temperature of formation.

DC A41 C04 E16 E17 E35 E36 H01 H04 H06 H09 Q49

IN BERCHENKO, I E; DE ROUFFIGNAC, E P; FOWLER, T D; KARANIKAS, J M; MAHER, K  
A; RYAN, R C; STEGEMEIER, G L; VINEGAR, H J; WELLINGTON, S L; ZHANG, E  
PA (BERC-I) BERCHENKO I E; (DROU-I) DE ROUFFIGNAC E P; (FOWL-I) FOWLER T D;  
(KARA-I) KARANIKAS J M; (MAHE-I) MAHER K A; (RYAN-I) RYAN R C; (STEG-I)  
STEGEMEIER G L; (VINE-I) VINEGAR H J; (WELL-I) WELLINGTON S L; (ZHAN-I)  
ZHANG E

CYC 1

PI US 2002029884 A1 20020314 (200246)\* 370p E21B043-30

ADT US 2002029884 A1 Provisional US 2000-199213P 20000424, Provisional US  
2000-199214P 20000424, Provisional US 2000-199215P 20000424, US  
2001-841306 20010424

PRAI US 2001-841306 20010424; US 2000-199213P 20000424; US 2000-199214P